HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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Published by

THE INDUSTRIAL PRESS
148 Lafayette Street
New York 13, N. Y

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Subscription Rates

Yearly subscription in the United States and Canada, one year, $3; two years, $5; three years, $6; in all other countries, $5 per year. Single copies 30 cents. Entered as second class matter, April 18, 1925, at the Post Office, New York, N. Y., under the act of March 3, 1879.

CONTENTS FOR JUNE, 1948

VOLUME 45 NUMBER 6

FEATURE ARTICLES

Maintenance of Foundry Ventilation Equipment..... 67
K. M. Smith

Simplifying Comfort Control for Radiant Heating..... 74
W. P. Chapman and R. E. Fischer

Review of British Experiments in Domestic Heating..... 78
C. Tasker

Corrosion of Underground Steam Line Supports..... 83
L. F. Collins, F. J. Schlachter and G. D. Winans

Air Conditioning Multi-Story Buildings..... 86

Joints for Plumbing and Laboratory Piping..... 89
J. E. York

Heat Gains from Lighting..... 94
H. E. Ziel

A Snow Melting Job Pays Off..... 95
T. N. Adlam

Test Every Air Conditioning System..... 96
L. T. Avery and J. Black

SHORT ARTICLES

Air Conditioning Crane Cabs..... 73

Caught by the Draft—*J. J. Woolfenden*..... 88

Calculating Machine for Heat Transfer Problems..... 93

Why Pipe Corroded—*T. W. Reynolds*..... 98

REFERENCE MATERIAL

Reference Data 367-368..... 98

DEPARTMENTS

Washington News—*Loring F. Overman*..... 63

The Sales Engineer—*Bernard Lester*..... 99

Experience is my Classroom—*T. W. Reynolds*..... 100

News of Equipment and Materials..... 103

Abstracts and Reviews..... 110

Degree-Days for April, 1948..... 111

News of the Month..... 113

New Catalogs..... 128

Industrial Degree-Days for April, 1948..... 136

Canadian Degree-Days for April, 1948..... 136

Getting Personal..... 136

Since the Last Issue..... 137

Convention Programs..... 141

Coming Events..... 142

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THIS MONTH'S COVER

Foundry ventilation, as emphasized by the cover illustration, is an important component of foundry operation. Proper functioning of ventilating equipment is based on sound and consistent maintenance. Illustrations on cover and page 67, courtesy of American Air Filter Co.

Meet The New Model "F"

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BETTER LOOKING!
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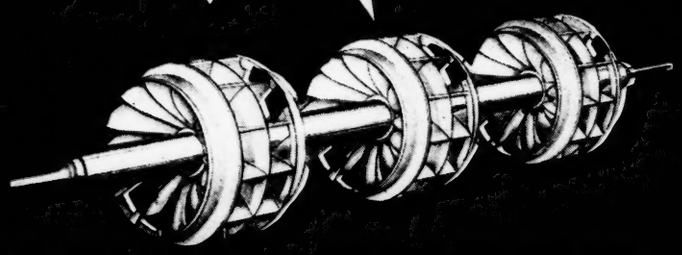
BETTER DELIVERIES!



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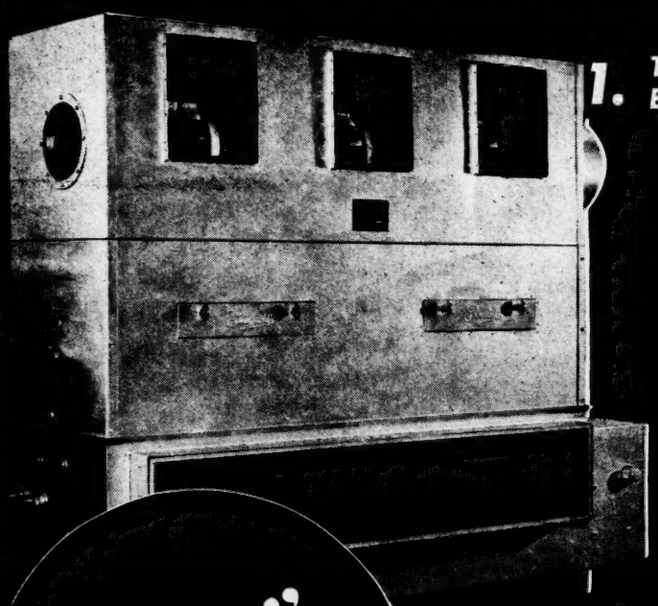

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"Buffalo" for Air Conditioning

Washington News

LORING F. OVERMAN

WASHINGTON was a city of growing tensions as May turned into June, with Congress going into honest-to-goodness night sessions, and plenty of them, in an effort to break the log jam of "must" legislation facing it before June 18, the day scheduled for summer adjournment. There were indications that instead of adjourning, Congress would merely recess for the period of the political conventions, returning to Washington to tackle again the stacked-up problems —some of them affecting the heating, ventilating and air-conditioning industries directly; some merely indirectly.

The tensions were not limited to members of Congress. Cabinet officers and their staffs were awaiting appropriations to carry on their work for the coming year. Federal employees were worrying about a proposed pay increase. Those who administer the new European Recovery Program were also awaiting appropriations to pay for the things Congress has already directed them to do. All in all, millions of persons were awaiting with bated breath the fate of a dozen appropriations measures.

As time will doubtless prove, much of their concern will have been misdirected, for Congress has a habit of making the taxpayers' money available for the Government departments to distribute. Occasionally it is necessary to transfer funds from one pocket to another, to be covered later by a deficiency appropriation, but few Government departments have ever gone out of business because Congress didn't make the money available.

Money First

Trouble with having appropriations bills pressing so close to adjournment (or recess) time is that Governments are like individuals. There comes a time when the importance of the dollar becomes so pressing that it seems necessary to solve money problems in order to view others in proper perspective. Thus the appropriations bills must go through, regardless of other pending matters, and there is always the danger that some determined member of Congress will tack one of his pet projects onto an appropriations bill as a "rider." Such tactics aren't considered strictly cricket, but they have been employed. If repeated once or more in the current session, with some controversial subject involved, resulting filibusters could stymie all remaining unfinished business.

House and Senate leaders were doing their best to prevent such a catastrophe, preferring to adjourn with all "must" subjects out of the way, rather than return after the Republican and Democratic national conventions to resume debates in the more rarefied political atmosphere that will precede the November elections. Outlook for adjournment on June 18 or 19 was not bright as May closed, most observers opining that a short recess would be the best that could be hoped for.

Pending "Musts"

Besides the eight pending appropriations bills, 10 important pieces of legislation were on the urgent docket at press time. Others may yet be added, including something to anticipate John L. Lewis' next move in coal. For the moment:

Housing. The House Banking Committee is again holding up action on the Taft-Ellender-Wagner housing bill, twice passed by the Senate. Efforts to secure signatures of 218 Congressmen on a petition to force the bill out of committee had netted only 128 signatures at press time. The House Committee is opposed to public housing and slum clearance features of the bill, which proposes the construction of 15,000,000 homes in 10 years. House Leaders indicate that unless the Senate will permit elimination of the public housing feature from the bill, there will be no housing legislation this session.

Tidelands. Of interest to the heating industry is this bill, passed by the House, giving the States title to tideland oil reserves. Similar Senate bill is held by the Judiciary Committee.

Draft. Of interest to all young men in the heating and ventilating industries, and to those who employ them, is proposed draft legislation. Both Senate and House Armed Services committees have approved peacetime selective service bills that would require two years' active duty for men 19 through 25 years. Favorable action likely.

Oleo taxes. House has approved repeal of all taxes on oleo margarine, and the Senate Finance Committee has completed hearings. Final action uncertain, due to likelihood of Senate floor amendments.

Displaced Persons. Admission of 100,000 or more displaced persons is the objective of this legislation, originating in the Senate.

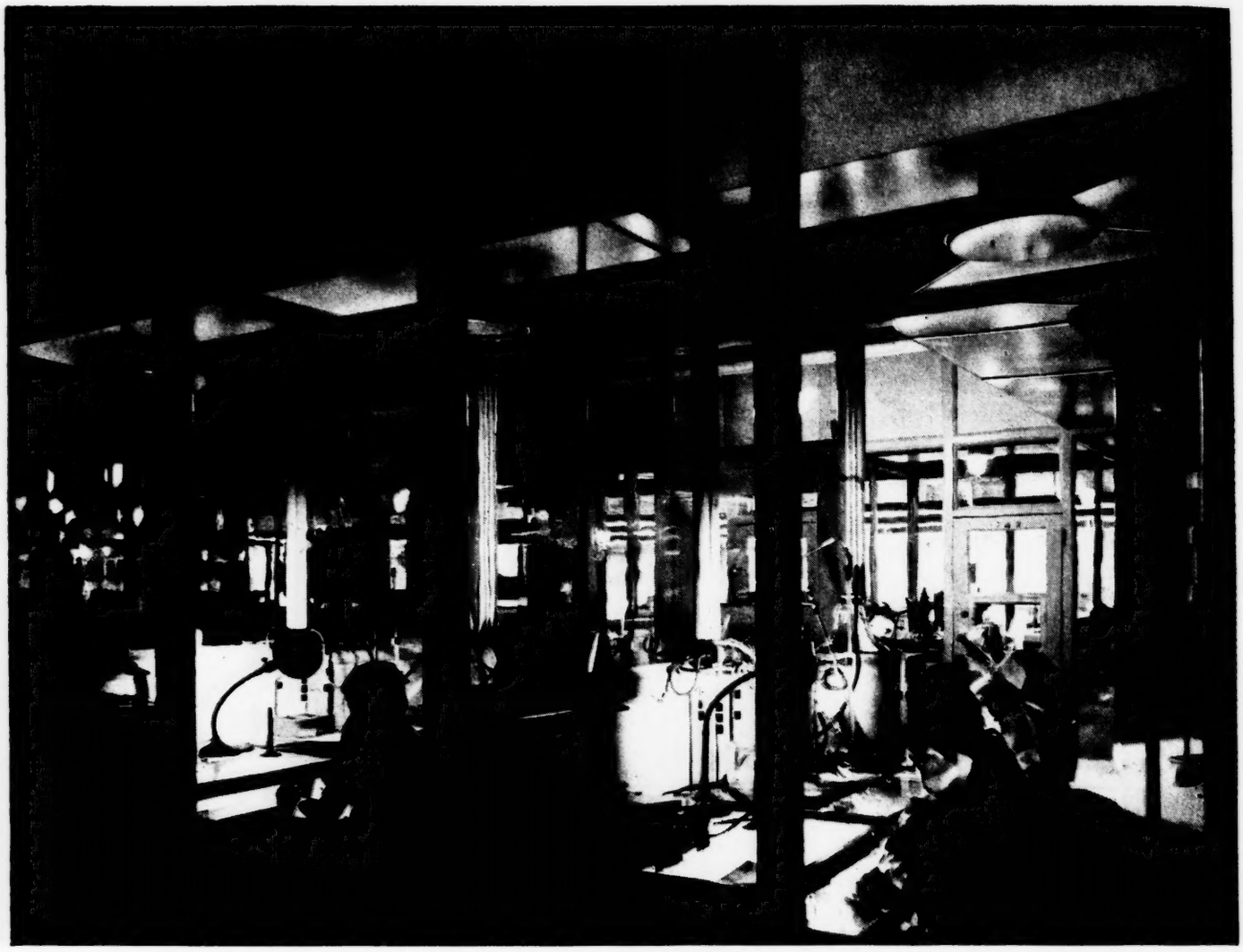
Reciprocal Trade. One-year extension of Reciprocal Trade Agreement Act contemplated. House version includes restrictions opposed by Administration.

Atomic Committee Tenure. Senate endeavoring to rush a bill extending for 23 months the terms of Chairman David E. Lilienthal and four other members of the Atomic Energy Commission. Administration proposes staggered terms of one to five years. Heated debates on floors of both Houses likely, with a Presidential veto anticipated.

Communist Registration. House passed the Mundt-Nixon bill, requiring registration and reports from Communists and Communist-front groups. Senate Judiciary Committee hearings must precede Senate action.

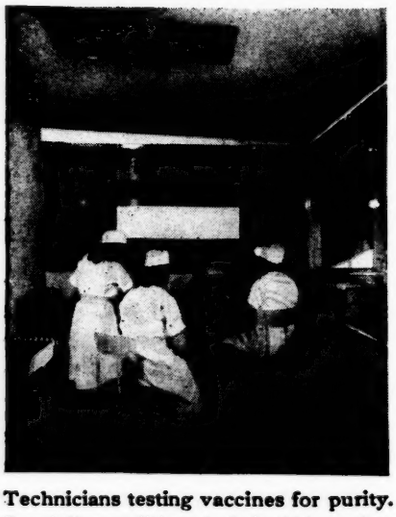
Farm Bill. Both Senate and House Agriculture committees urge passage of similar long-range farm bills, but Senate group is not in agreement on details.

Government Pay. Increases are favored by both Senate and House Civil Service Committees, but amounts recommended differ.



Glass-enclosed sterile rooms of the Sharp and Dohme laboratories where vaccines and other biological products are bottled. Surgically clean, these rooms are ventilated by overhead ducts that carry filtered, conditioned air. Many of the ducts in the Sharp and Dohme laboratories were made from Beth-Cu-Loy Galvanized Steel Sheets.

Vaccines are processed in these air-conditioned rooms



Technicians testing vaccines for purity. Specially-conditioned air is delivered to this room by ceiling ducts. Ultra-violet light is used here as a further guard against contamination.

Air conditioning has come to play a vital part in the preparation of biological and pharmaceutical products for medical use.

An example is found in Sharp and Dohme's Philadelphia laboratories, where special air-conditioned sterile rooms have been provided for the processing of biological and sterile pharmaceutical products. The circulating air is conditioned, filtered, and finally sterilized by ultra-violet rays. This eliminates airborne bacteria, reduces contamination losses, and assures purity of the finished products.

Many of the ducts that carry air through this plant are made from Beth-Cu-Loy (copper-bearing) galvanized steel sheets. There are several sound reasons why Beth-Cu-Loy sheets are widely used for jobs of this kind. They have superior resistance to atmospheric corrosion. They are easy to handle, to cut, to seam, and to solder. And they cost very little more than ordinary galvanized steel sheets.

Bethlehem Steel Co., Bethlehem, Pa.

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BETHLEHEM STEEL

Coal Problem

In addition to the foregoing "musts," and any others that may develop before the zero hour, Congress recognizes that it should do something, if possible, about the constantly recurring coal strikes. There were few indications, at press time, that a new contract would be signed before miners take their annual vacations on June 26, and it was being assumed that under their "no contract, no work" policy, they will fail to report back to the mines when vacations end on July 5.

Under present legislation, all the Government could do in such an event would be to stop the strike by injunction — until October. With cold weather approaching, the miners' bargaining position would be enviable. There is considerable sentiment in Congress to deal once and for all with the coal stoppage problem, and the temper of members of Congress probably will not be improved any if miners' vacations preclude vacations for Senators and Congressmen.

Oil Crisis Too

Nor is coal the only fuel posing a problem for Congress—and for members of the heating industries. A congressional sub-committee, investigating petroleum in relation to national defense, turned up some startling per capita figures that help explain the increasing tightness of oil supplies. Per capita consumption in 1947, the investigators found, was 608 gallons —equal to 14 42-gallon drums with four 5-gallon cans left over—for every man, woman, and child in the United States. This increase from 1938, when per capita consumption of petroleum products was 367 gallons, is 63 percent.

Comment the Congressional probers:

"This startling increase in consumption is derived mainly from two facts:

"First, the instruments consuming oil—residential oil burners, automobiles, Diesel locomotives, tractors, buses, airplanes—can be produced and are being produced more rapidly than oil wells, pipelines, refineries, and tankers.

"Second, the public prefers the use of oil to coal due to a variety of causes, not excluding the gyrations of the leaders of the United Mine Workers, who, as one witness observed, 'is the best oil salesman the industry has had'."

Whatever the reasons, the probers were told that domestic oil burner installations during 1946 and 1947 in new homes, conversions from other fuels, and replacements of wornout burners aggregated 1,300,000 units. The increase was 81 percent greater than all the burners similarly installed in the previous 11 years.

Thus, again, the picture changes. Once of greatest concern to manufacturers of oil burners was the availability of steel, castings, motors. Now must be added the lack of fuel to power the burners themselves.

Perhaps the answer lies, in part at least, with those who engineer the industry's products. Might it be possible to increase the efficiency of burners, of controls, of insulation? Quickest way to double the oil supply would be to make one gallon do the work of two. Impossible? Could be, but when an industry encounters some obstacle that seems insurmountable, it is sometimes encouraging to recall what other industries have done in similar circumstances.

The carbonated beverage industry, for example, tells a story of bumping into a stone wall back in 1892. At that time its total annual volume was valued at only $15,000,000 wholesale, for soft drink bottling was a hand operation, its output limited to the fact that bottle corks or stoppers had to be wired on by hand. To make the situation look even more hopeless, 1,500 patents on stoppers of various types had been granted by the U. S. Patent Office. Surely no one could think up a new one! Yet one William Painter of Baltimore did just that. Instead of developing another stopper to fit inside the bottle neck, Painter patented one that put the cork on the outside—a crown cap. This simple but revolutionary development made it possible to mechanize the soft drink industry. Last year it estimated its products, at wholesale, at $705,000,000!

Does the oil burner industry have a William Painter?

A Word About Babies

With Congress concerned with appropriations, and coal, and oil, and a dozen other things, another group in Washington is worrying about babies. The Federal Security Agency, U. S. Office of Education, has noted with alarm that the war years' bumper crop of 5,000,000 babies is rapidly nearing school age, and with facilities completely inadequate to take care of them. School construction expenditures for 1948 are estimated at $375,000,000, which was less than was spent in 1939, and which sum buys only about half as much in school plant.

All in all, it is estimated that at least $11 billion should be spent on new schools and equipment in the next 10 years if the nation's educational facilities are to be kept at even the prewar standard. This increasing concern over the school situation is of direct interest to readers of this column because of the tremendous potential market the subject introduces.

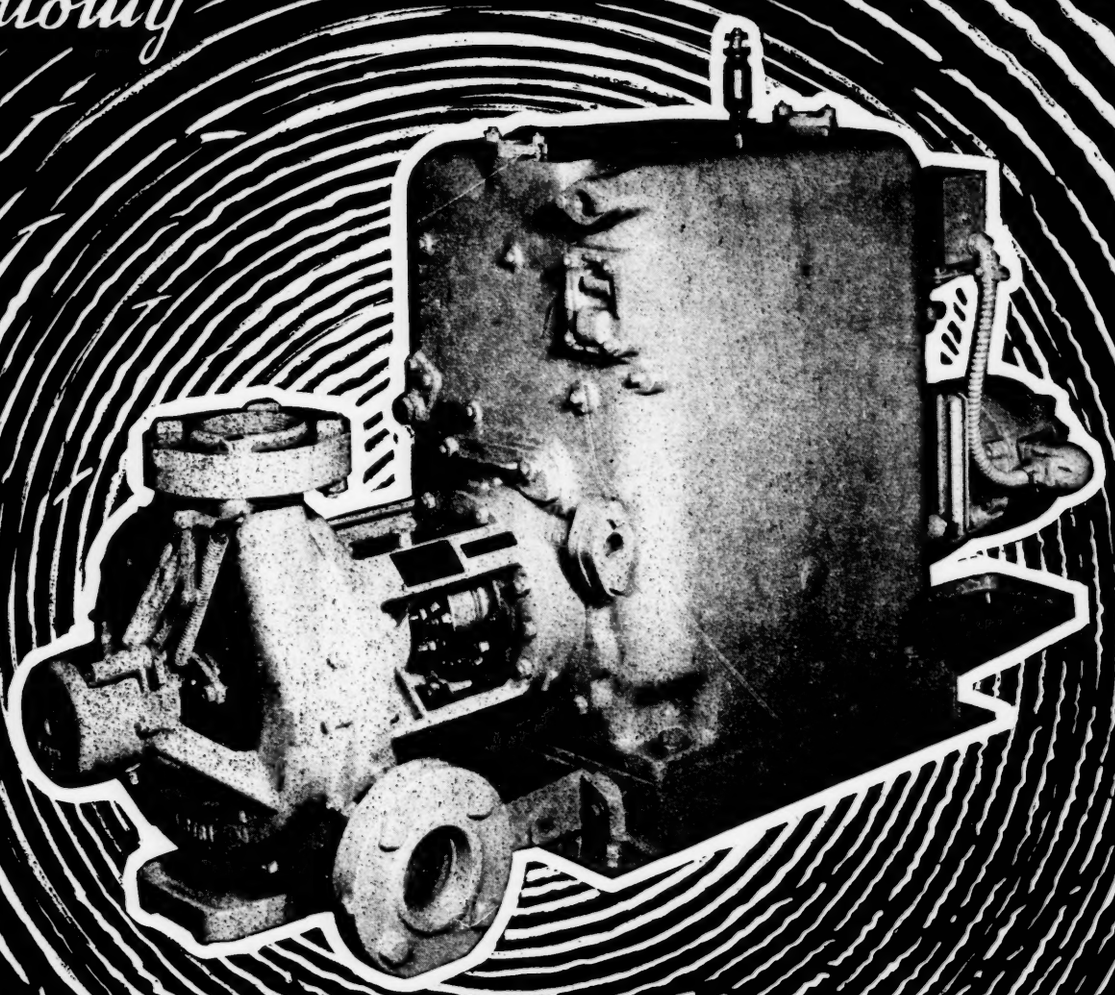
Nor is the need limited to the tiny tots. The Office of Education, to illustrate the need for college buildings, observes that minimum requirements during the next two years would involve buildings having space equal to 76 of Washington's famous Pentagon buildings. Built to provide offices for 40,000 War Department workers, this building's air-conditioning unit starts with a battery of 12 1000-hp compressors.

The need for all these additional educational facilities has been recognized and is being publicized.

Armed Services Purchases

New regulations outlining a uniform procurement system covering everything that the Army, Navy, and Air Forces will purchase in the future, have been issued by the three services. The new regulations and policies to be followed jointly by the three services became effective May 19, and have been described as leading to greater efficiency and flexibility in purchasing millions of dollars worth of goods and equipment. Copies are available at 25c each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Centralized Heating Economy



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THE NASH ENGINEERING COMPANY
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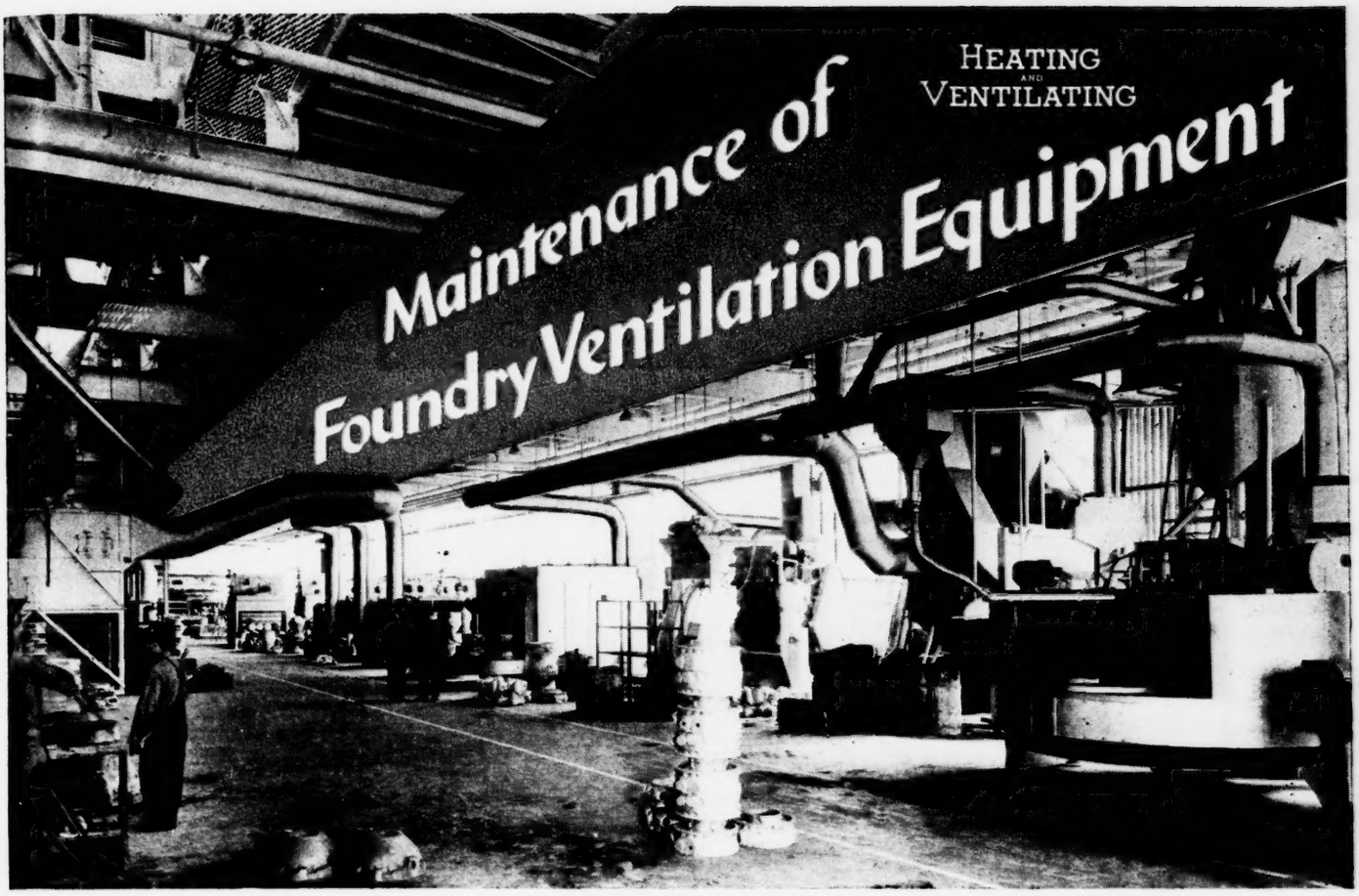


KENNETH M. SMITH
Foundry Engineer, Caterpillar Tractor Co., Peoria, Ill.

Suggestions for the maintenance of ventilation equipment used in foundries to prolong the life of the units and to increase operating efficiency. Attention is directed to the troublesome parts of the ventilating equipment and the steps to correct conditions.

GOOD maintenance of foundry ventilation equipment begins on the drawing board, for the designer must provide ruggedly built equipment with ample provisions for convenient service by the maintenance organization.

Adequate equipment and controls should be supplied to secure a fully balanced air heating and exhaust system and to assure the proper functioning of all the ventilation equipment. To expedite this balancing at least 5% more air should be supplied to the foundry building than is removed by the exhaust systems.

Operating maintenance of this ventilation equipment will require tinners, millwrights, electricians, and pipefitters under a supervisor who is thoroughly familiar with the details of the ventilation systems and the problems of each maintenance craft, and who has adequate time to thoroughly check the operation of the ventilation systems.

Air Heaters

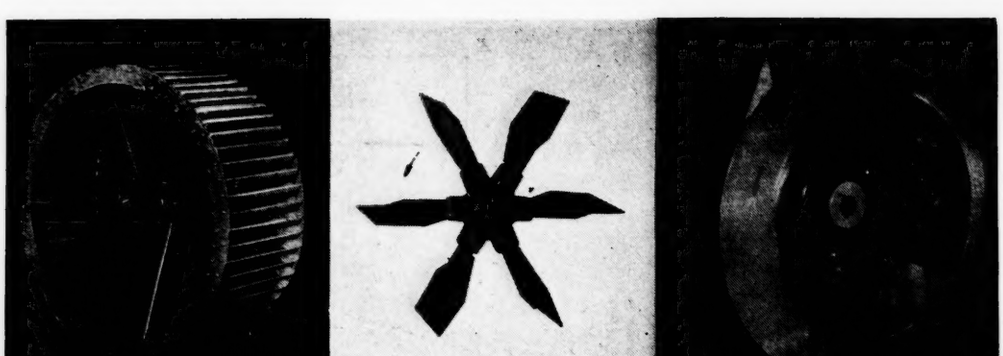
Air heater maintenance is a year around requirement since the heater fans are usually used for air circulation during the summer months.

Heater coils should be cleaned regularly both winter and summer unless the heater contains a by-pass around the coils for summer use. These coils should be of the non-freeze type which give a more uniform steam distribution for direct heating of outside air during the winter months to preserve the building ventilation balance. Check the condensate traps for scale accumulations and leaking seats. To protect the steam coils from freezing, in case of a condensate trap failure, a thermostat can be installed in the heated air discharge duct to control the cold air intake damper. This same thermostat can be used to control the air recirculation damper which will prevent the discharge of cool air from the heaters during extremely cold weather.

In all cases, the dampers and control equipment should be set to maintain the proper conditions for each season of the year. Automatic and safety control equipment should be checked regularly to insure proper functioning.

Heater fan impellers should be cleaned regularly especially the multiblade squirrel cage type where dirt accumulations cause a drop in efficiency and give rise to excessive vibration.

All discharge ducts should be kept tight and securely anchored. Avoid the indiscriminate use of robbers in the ducts.



Courtesy, Sturtevant Division, Westinghouse Electric Corp.

Left to right, Fig. 1. Multi-blade squirrel cage centrifugal fan impeller. Fig. 2. Radial blade paddle wheel centrifugal fan impeller. Fig. 3. Backward inclined blade non-overloading centrifugal fan impeller.

Hoods and Ducts

The first principle of foundry exhaust hood design is to make the hood rugged. All hoods should be constructed of not lighter than 16 gage material and hoods subject to medium abuse should be 10 gage material. Crane serviced shake-out hoods should be constructed of at least ¼ in. plate. Use plenty of bumper rails and tie bars to preserve the hood entrance shapes. However, sharp edge hood entrances should be avoided wherever possible by using rounded openings or standard pipe. Never use sharp edge holes cut into a flat plate as a hood face. Two or 3 in. standard pipe or curved edges on face plates permit far better air distribution over a hood face with lower air handling horsepower.

All hoods around equipment should be installed with equipment maintenance in mind. Sturdy and convenient doors should provide entrance for greasing, inspection, and cleaning of all equipment. Bolted panels should be used, if hinged or sliding doors cannot be used, to permit the complete removal of the equipment. Frequently mold conveyor cooling tunnels are constructed too low and too narrow for convenient removal of dislodged flasks and jammed cars. When convenient doors and panels are provided around equipment, the maintenance man should be fully responsible for keeping the doors closed and the removable panels bolted tightly.

All hoods should be protected by baffles from cross drafts wherever possible. Internal baffles should be used on elevator and belt discharge points to reduce the sand pickup by the exhaust air velocity. Down draft shake-out exhausts need very careful baffling or a large pit to act as a plenum chamber for separating the sand from the smoke.

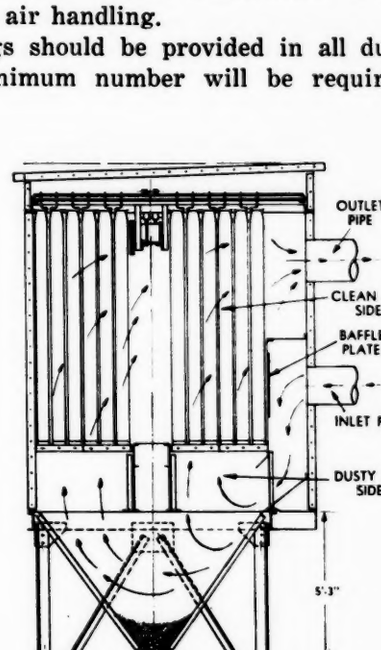
Exhaust hood faces and interiors, especially those in mold pouring, cooling, and break-apart zones, should be cleaned regularly to reduce the fire hazard from core oil and soot deposits. A steam jet system for smothering fires should be installed in the ducts connected to such hoods. Opposed steam jets will counteract the aspirating effect of one upward jet; the downward jet will also feed steam back into the exhaust hood. The steam jet valve should be conveniently reached from floor level, and the fan stop button should be by the steam valve so the fan can be turned off immediately. Check the steam jets at regular intervals.

Ducts should be made of not less than 20 gage material when they handle ventilation air. Ducts with a diameter or maximum dimension of from 18 to 30 in. should be made of 18 gage material. Ducts over 30 in. should be made of 16 gage material.

Ducts for abrasive air handling in exhaust systems should be made of not less than 16 gage material when the diameter is not greater than 30 in. Ducts over 30 in. should be made of not less than 14 gage material. Long unsupported sections of duct may require heavier material.

Wherever possible, ducts subject to abrasion on one side should be constructed in flanged sections so the duct section can be turned to a new position before any side is worn through, thus accomplishing a longer duct life. Other parts of dust exhaust systems subject to heavy abrasive wear can be profitably equipped with removable heavy gage wear sections. Points to check regularly for abrasive wear include backs of elbows, transitions, main ducts opposite branch inlets, and fan housings. Small primary separators at tumbling mill connections will reduce the abrasion on those ducts. Welded rather than riveted construction is desirable for abrasive air handling.

Clean-out openings should be provided in all duct systems, but a minimum number will be required



Courtesy, American Wheelabrator & Equip. Corp.

Fig. 4. Vertical cloth tube dust collector.

where high duct velocities of 4,000 fpm and up are used or where the ducts are large enough to crawl into. Tight seals should be furnished on doors in pressure ducts to eliminate dust leaks into the foundry building.

Remove dead runs or low velocity runs of piping in dust collector systems to prevent the filling up and collapse of the duct. Ducts serving tumbling mills are especially dangerous in this respect. Any duct with capped branches should be viewed with suspicion.

If ducts plug up during cold weather only, condensation in the duct may be the trouble. The remedy is insulation of the duct, installation of air heaters in the area if the duct is inside a building, or direct application of heaters to the duct.

Horizontal runs of ducts attached to mold conveyor pouring, cooling, and break-apart hoods should be checked and cleaned regularly to prevent the accumulation of combustible materials. Core ovens and ducts should be checked regularly for the same reason.

All volume control dampers for exhaust hoods and duct branches should be kept in proper adjustment with the settings marked on each control so the proper settings can be easily duplicated. To prevent unnecessary heat losses, do not over-ventilate exhaust hoods. Hoods over transfer points of sand handling systems should be carefully baffled to prevent unnecessary loss of bonding materials and sand fines.

A convenient method of checking for changes in the operating characteristics of air handling systems is to drill and tap ⅛ in. pipe size holes in ducts near exhaust hoods and fans and in dust collector housings. A glass or plastic U-tube with a rubber tube and one-hole rubber stopper attached to one leg can be used to obtain an approximation of the static pressure at any point. As duct turbulence will give erratic readings at some points, find a point where stable readings can be obtained. The desired ventilation volume should be measured by air velocity instruments and the test hole reading noted. By periodic checking, the permissible variation at the test hole can be established and marked directly at the most important test points. Thus the maintenance man can tell by a single check whether an inspection, adjustment, or cleaning is in order.

Fans

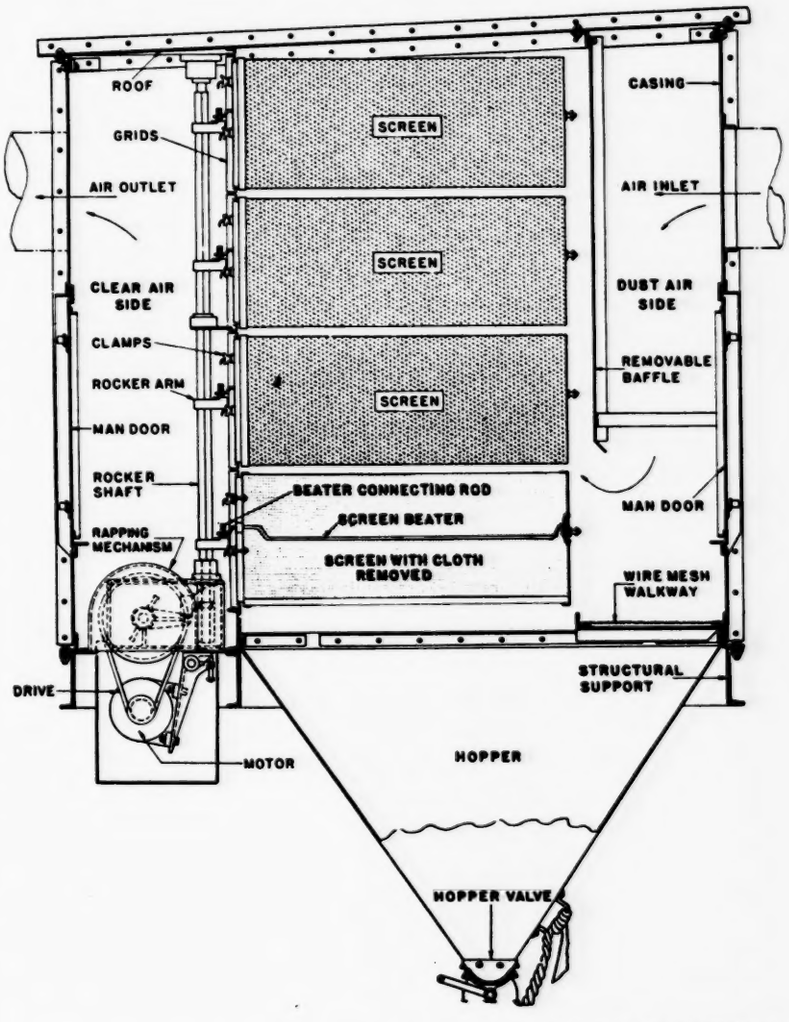
A very important point in reducing fan maintenance is the original choice of fan type for the individual system. Multiblade squirrel cage centrifugal fans, Fig. 1, are not suited to foundry work. The narrow curved blades collect dirt too readily for reliable operation over prolonged periods. They should be replaced by either a radial blade paddle wheel centrifugal fan, Fig. 2, or by a wide backward inclined blade non-overloading centrifugal fan, Fig. 3. The air volume handled by these last two fan types will not change too quickly when they are handling dirty air.

Where existing multiblade squirrel cage centrifugal fans can not be readily replaced by a radial blade centrifugal fan, a regular program of cleaning should be established. This cleaning will be expedited on any type of centrifugal fan if a section of the fan scroll sheet is made removable. This removable section must be provided with sturdy clamps and tight seals.

Standard propeller type fans can be used for smoke and fume exhaust systems provided the air temperature is approximately not above 180F. Propeller fans with special provisions for cooling the bearings can be used for temperatures up to 300F.

When the top bearing of a vertical duct fan gives trouble, a grease seal both above and below the bearing, with a separate grease line to the bearing, will usually lengthen the life of the bearing.

When the air handled by propeller fans contains any appreciable amount of dust, the impellers wear out faster than those of centrifugal fans. Adequate doors with sturdy and easily operated clamps and tight seals to prevent air leakage should be built in the duct fan housing or in the duct immediately above or below the fan, to expedite the cleaning and changing of propeller blades. Large mesh screen should be in-



Courtesy, Pangborn Corp.

Fig. 5. Cross section of flat cloth envelope dust collector.

Courtesy, Buell Engineering Co., Inc.

Fig. 6. Cutaway view of a dry cyclone dust collector.

stalled below or around propeller fans wherever a propeller failure could cause personal injury. Roof installations are frequent offenders of such safety precautions. Check the installation of propeller fan blades. Often they are installed wrong side up, and the efficiency is low when they are running in the reverse direction.

Check the rotation of centrifugal fans too. Many of them will give partial air delivery even when running backwards.

All foundry fans should have well sealed ball or roller bearings. Ring oiled babbitt bearing boxes are too easily contaminated with abrasive dusts in foundry installations. Most centrifugal fans can be equipped with standard dustproof pillow blocks which can be changed readily. Usually these pillow blocks are interchangeable with those used on other foundry equipment.

Fan bearings should be greased on a regular schedule, but precision type pillow blocks should not be overgreased. Centrifugal fan bearings, under ordinary conditions, will run up to a month without regreasing. Duct fan bearings should be greased more frequently.

Fans should be inspected for undue vibration, defective bearings, missing belts, and eroded housings before each weekend shutdown to expedite repair during the weekend.

Keep fan drives in good condition. All belt drives should have convenient takeups to permit easy adjustment to the proper belt tension. Centrifugal fan drives usually have a sliding motor base, but duct fans frequently need a hinged type motor mount for more convenient belt adjustment. Do not run drives with part of the V-belts missing. Premature failure of the remaining belts may cause an unnecessary shutdown of production equipment.

Whenever fan impellers are repaired, they should be very carefully balanced before reinstalling in a fan.

When centrifugal fan impellers are mounted directly on the motor shaft or where fan impeller removal time must be as short as possible, a section of the centrifugal fan housing should be made removable to permit the changing of the impeller without disturbing the fan body or the attached ducts.

All foundry motors should be of the totally enclosed or totally enclosed fan cooled type with grease lubricated ball bearings. Greasing should be done at intervals recommended by the motor manufacturer. Do not overgrease. The air passages through the motor housing should be blown out occasionally to reduce motor heating.

Dust Collectors

A variety of dust collectors are used in foundry exhaust systems. These collectors can be classified as the dry cloth type using vertical cloth tubes, Fig. 4; flat cloth envelopes, Fig. 5; dry cyclones either as a single unit, Fig. 6; or as a multiple of small units, wet cyclones, Fig. 7; dry or wet rotary centrifugal types, Fig. 9 and 10, and the turbulent water bath type, Fig. 11 and 12.

All collectors should be thoroughly inspected regularly, and frequent checks should be made of the pressure loss through the collector. Connections for a U-tube should be installed on all collectors for this check. The material collection hoppers of all collectors should be kept emptied to prevent the recirculation of the material within the collector. In dry collectors this recirculation wears out the collector parts, and in the case of the dry cyclone, the collected material will carry through the collector. In wet collectors excess sludge will build up on the collector parts, increase the collector pressure drop, and carry through the eliminators to throw the fan impeller out of balance if the collected material is not properly removed.

Weighted damper discharge valves for dry collectors should always work freely. Often rotary discharge valves which may require excessive maintenance can

Courtesy, Claude B. Schneible Co.

Fig. 7. Wet cyclone dust collector.

be replaced by well sealed manually operated valves or by heavy canvas sleeves which can be tied shut. Hopper discharge valves should never be allowed to leak dry dust.

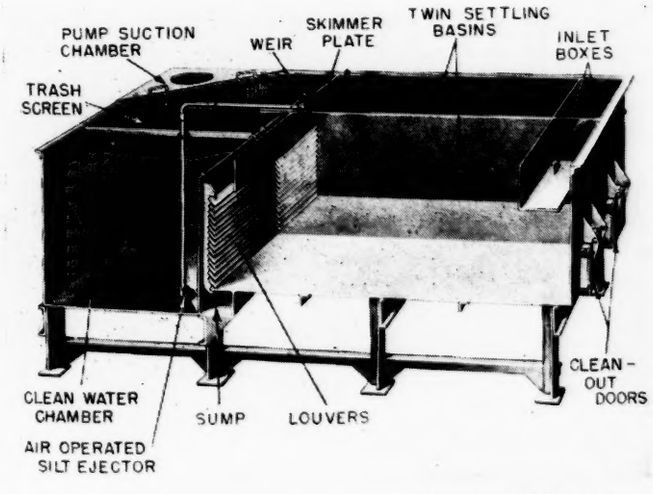
Cloth Type Dust Collectors

The cloth collector should not be used where large amounts of steam or core oil vapors, high temperatures, or gummy materials are present in the air stream. However, they are very efficient for collecting fine dry dusts when they are well maintained.

Ordinarily a set of cloth envelopes or tubes will last for several years of 24 hours per day service. Eventually sufficient lint will have built up in the cloth pores to increase the collector resistance too much, or the rapping devices will have worn holes in the bags or tubes. All envelopes or tubes should be securely fastened into the headers. To prevent premature wear or tearing of the cloth envelopes, they should not be stretched too tightly at assembly in the collector. Also cloth tubes should not be under tension at the upper end of the shaker stroke.

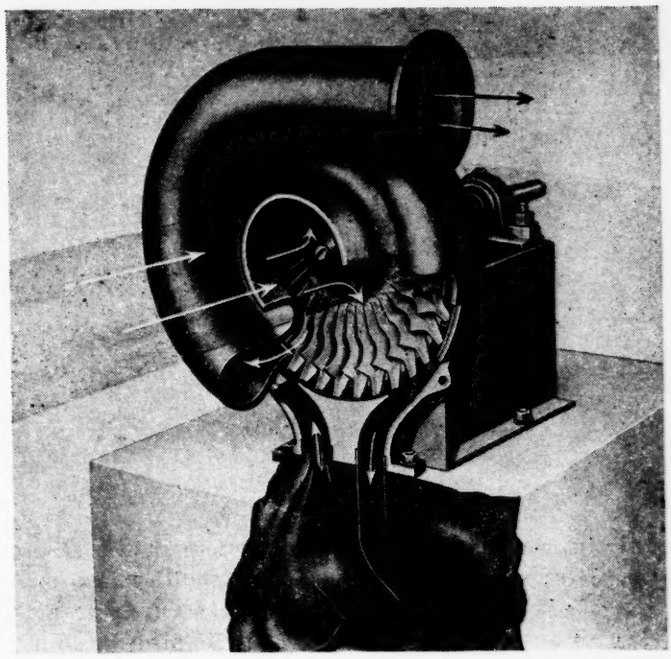
On old style large area flat cloth screen collectors make sure that the cloth faces cannot collapse together when under suction. It is advisable to replace these old style collectors with the new style cloth envelope or tube collector because in the new style collectors the failure of any individual envelope or tube can be easily detected and the defective envelope or tube quickly replaced. Check cloth collectors from the clean air side. Dust leaks will be shown by dirty envelopes or tubes, and dust deposits will be found within the defective cloth envelope.

All cloth collector envelopes or tubes should be fireproofed since the cost is relatively small, and the widespread use of welding for construction and maintenance work can easily ignite combustible cloth. For added protection, a spark screen and a baffle plate should be installed opposite the inlet to a cloth collector to extinguish sparks in the air stream, and to prevent heavy particles from impinging on the collector cloth. The spark screen should be fitted with a rapping device to remove lint and paper.



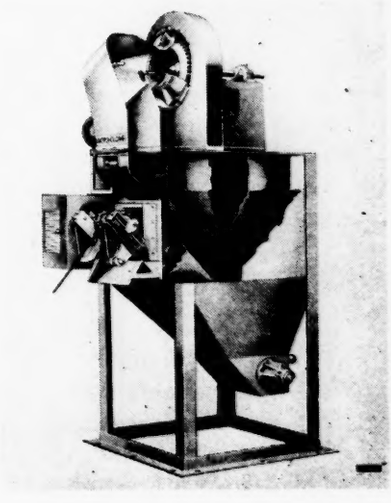
Courtesy, Whiting Corp.

Fig. 8. Manual twin type sludge dewatering tank for wet dust collectors.



Courtesy, American Air Filter Co.

Fig. 9. Dry rotary centrifugal dust collector.



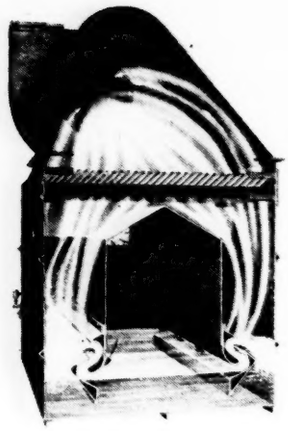
Courtesy, American Air Filter Co.

Fig. 10. Wet rotary centrifugal dust collector. Arrow indicates drag chain sludge conveyor.

All cloth collectors should be rapped or shaken down regularly with the fan turned off. Frequently a relay and timer will be helpful to operate the rapping device when the fan can be shut off during lunch hours or when the shift changes. Pressure loss increase through the collector should be watched to make sure that the rapping is done frequently enough. A shakedown every 4 hr will usually give efficient operation. While the maximum pressure drop should be approximately 4 in. w.g., 3 in. is a more desirable maximum. If the operating pressure drop is greater than 4 in. after the collector has been thoroughly rapped, the collector is handling too large an air volume per square foot of cloth (maximum volume is 4 cfm per sq ft), or the pores of the cloth are clogged. The complete rapping mechanism including the individual rapping hooks or cranks should be checked during the regular inspection of the collector envelopes or tubes.

Dry Cyclone and Multiple Cyclone Collectors

The chief troubles with dry cyclone collectors are abrasion of the collector shell and plugging with



Courtesy, American Air Filter Co.

Fig. 11. Turbulent water bath dust collector.

sticky or wet material or with papers in the case of multiple cyclone collectors using multi-vaned swirl rings. The best way to combat abrasion is to make the collector of heavy material. Make all collectors of not less than 10 gage material, and in proven cases of severe duty ¼ to ⅜ in. plate will be necessary. In such cases removable wear plates and flanged sectional construction are useful. Oftentimes rubber liners are used to combat abrasion.

The individual cyclones should be kept tightly sealed into the inlet header of multiple cyclone collectors. Paper can be kept out of these collectors by using screens at the duct entrances. When necessary, chains suspended in the center of the individual small cyclone tubes will keep the tubes relatively free of sticky material.

Wet Cyclone Collectors

The wet cyclone, Fig. 7, should be supplied with a plentiful flow of clean water. If possible this water should not be recirculated, but where recirculation is necessary adequate settling tanks must be provided and properly operated. The water supply system should be interlocked with the fan to prevent operation of the fan without water flowing through the collector. The water should flow through the collector for a half hour after the fan is shut off in order to thoroughly flush the collector. At not less than weekly intervals the following things should be done. Check any water spray nozzles for plugging; check for and remove unusual accumulations of material on the collector shell or in the swirl vanes; clean the eliminator plates if necessary; and check the fan impeller if the eliminator plates are very dirty.

Where the volume of solids collected is not large, a twin manual type settling tank, Fig. 8, is frequently used. Where large volumes of solids are collected, either a drag chain sludge conveyor as shown in Fig. 10 is used to empty the settling chamber, or a series of large size settling basins or tanks is used which can be unloaded by a clam shell bucket or by opening the bottom of the tank to allow the solids to drop into a car or truck.

When the twin manual type settling tank is used, the sludge depth should not increase to more than one-third of the effective tank depth before switching the collector discharge to the other settling tank. The accumulated silt should be removed from the clear water chamber every 4 hours.

Where large settling basins or tanks are used, they should be arranged with a cascade system that will allow the recirculation pump to take its water from a tank with silt-free water.

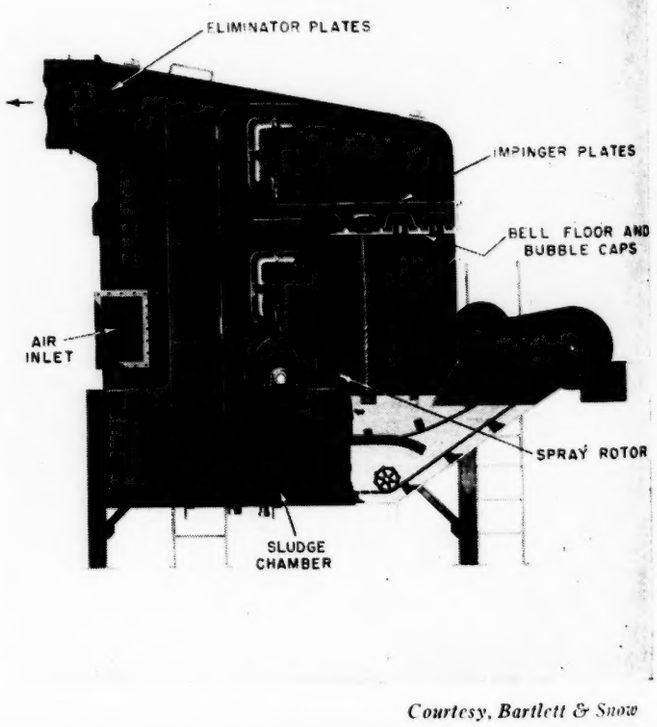
The recirculation pump should be constructed of abrasion-resistant materials, and provisions should be made for flushing the piping to remove any accumulated silt.

Deposits of material will usually build up slowly throughout the wet cyclone collector. They should be thoroughly cleaned and repainted with rust preventive paint every 3 to 5 years. Access is provided to the various collector stages to permit this reconditioning.

Rotary Centrifugal Collectors

Rotary centrifugal collectors, Fig. 9, combine the collector and fan functions in a compact unit. They are used as wet or dry collectors depending upon the collection requirements. The dry rotary centrifugal collector should have liners in the dust collecting chamber to prevent wearing out the main collector casting. For heavy loadings it should also be provided with a pre-cleaner assembly. After prolonged heavy service, the dust separating tips on the impeller may wear off. The manufacturer provides a reblading service for the replacement of worn impellers. An opening is provided in the impeller housing for inspection purposes. Empty the dust hoppers regularly. Do not allow the dust to have a chance to recirculate through the collector.

The wet rotary centrifugal collector must have adequate clean water for the sprays. A poor spray leads



Courtesy, Bartlett & Snow

Fig. 12. Rotary type turbulent water bath dust collector.

to dirt buildup on the collector and impeller surfaces. Core oil fumes should not be put through this type of collector for they condense on the cold impeller blades and accumulate solids which throw the impeller out of balance.

The interior surfaces of the collector should be thoroughly cleaned and repainted every 3 to 5 years.

The discharge duct drain pipe must be kept open. Otherwise a water trap may form which will reduce or stop the fan output.

The sludge conveyor for any wet collector should be inspected regularly so new parts can be installed before failure occurs. Usually these conveyors are run continuously so accumulated sludge will not harden and overload the conveyor. Adequate and easily removed wear plates should be a part of all such conveyors.

Turbulent Water Bath Collectors

Since the turbulent water bath collector, Fig. 11 and 12, has baffles which force the air to travel through the water bath, its chief maintenance points are dirt buildup on the baffles and on the water eliminator plates plus the usual maintenance of the sludge removal equipment. Where a power driven rotary turbulence device is used, it must be kept clean to prevent vibration. The water level regulator should be kept in good condition to prevent low water levels or unnecessary water wastage. The interior surfaces of the collector should be thoroughly cleaned and repainted every 3 to 5 years.

Conclusion

A well planned and operated preventive maintenance program for foundry ventilation equipment will not only prevent most equipment breakdowns, but it will provide cleaner and more comfortable working conditions in the foundry. It will result in more efficient production with a reduction in costs due to mechanical troubles.

Air Conditioning Crane Cabs

Operators of crane cabs handling hot metal have to work high above floor level, subject to considerable discomfort from heat, dust and irritating gases. Many attempts have been made to better their working conditions through the use of cooling by cakes of ice and later by solidified carbon dioxide or dry ice. Evaporative cooling has been used to keep down first costs. The latest approach is through mechanical refrigeration units.

As pointed out by B. R. Small, Aluminum Company of America, in his bulletin on Air Conditioned Crane Cabs, published by the Industrial Hygiene Foundation, the degree of cab cooling with mechanical refrigerating systems can be specified on either of two bases.

1. A temperature differential with respect to the average maximum building temperature that ranges with the indoor variations from 78F in cool weather to 83F in hottest weather.

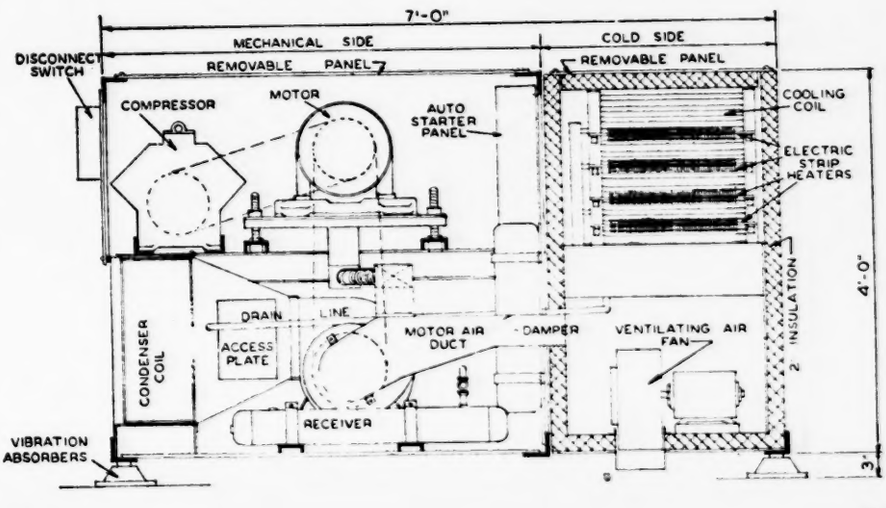
2. A fixed cab temperature of about 81F to be held regardless of room heat.

The sliding temperature differential basis is considered to be more practical as it permits greater economy in the selection of the size of the mechanical refrigeration unit.

The air conditioner selected must be specially designed for crane cab duty and, together with the air purifying equipment, should be constructed as a self-contained unit. The factory built unit has the compressor, condenser, refrigerant piping and accessories installed and inspected under controlled conditions followed by tests for gas leaks and general performance.

Freon-12 was used in cab units until 1945; since then, F-114 has been used, because of its superior properties. Under atmospheric pressure F-114 boils at 38F as against —21.6 for F-12.

Several manufacturers are now producing refrigeration cab coolers. For example, one model with a cooling capacity of 24,000 Btu per hour is generally installed on cabs in excess of 300 cu ft and exposed to high temperatures such as would exist around a soaking pit crane. For air cleaning, the factory-built units are provided with viscous filters or electrostatic filters. Activated carbon is used for gas and fume removal. The containers of activated carbon are exhausted in from 6 to 15 months depending on the degree of atmospheric contamination. Electric strip heaters are provided for heating in winter.



Manner in which the refrigeration equipment is divided into two sections in a Dravo crane cab cooler. The cooling coils are in the cold section and the refrigeration equipment, motor and starters in the mechanical compartment.

Simplifying Comfort Control for Radiant Heating

W. P. CHAPMAN and R. E. FISCHER

Product Engineering Department, National Tube Company[1]

This is a rational, mathematical defence of the premise that an inside air thermostat is adequate to control certain radiant heating installations where the thermal capacity of the panel is such that it responds more readily than the structure itself and at least as readily as the occupants.

UNDER conditions of ideal comfort in radiant heating, the inside air temperature will decrease as the heating load increases. This paper will show mathematically that such an inside air temperature reduction is usually less than two degrees Fahrenheit during a daily heating period; and that therefore, a control device responding only to inside air temperatures will suffice for many operating conditions. With extreme seasonal variations of outside air temperature, from 70F to —30F, one or two adjustments may be necessary.

In the following examples it has been assumed that the structure comes to thermal equilibrium immediately; that is, it has zero thermal capacity. From the standpoint of on-off thermostat control, this is the worst possible theoretical case and is actually impossible. Residences usually have sufficient thermal capacity to delay the effect of immediate temperature drop of the outside air; interior conditions are not affected for several hours. The main precaution in actual practice is to be certain that the panel responds more readily to required changes in panel temperature than the structure responds to changes in outside air temperature.

Since the inside air temperature will be constant, then either the panel area or panel temperature must fluctuate to satisfy the change in heating load. At all times the comfort equation, $t_a + ut_p + vt_e = 140$ as set forth by Raber and Hutchinson (1)*, must be satisfied. The terms of this equation are defined as:

t_a = inside air temperature, F
t_p = panel temperature, F
t_e = equivalent temperature of unheated surface areas, F
u = fraction of total room area that is panel
v = fraction of total room area that is non-panel

The value of t_a is fixed by the thermostat, t_e is a *resulting* temperature depending on the design conditions and outside air temperature; therefore, the value of t_p must vary to maintain comfort.

Fig. 1 is a plot of panel temperature vs. outside temperature for a room with an equivalent over-all coefficient of heat transmission (U_e) of 0.20 Btu per (hr) (sq ft) (F), panel area (u) equal to 0.18 or 18% of total room area, and a specific ventilation rate (V_c) of 1 cu ft per (sq ft) (hr). For a change in outside temperature of 40F the panel temperature must change 25F, *but the inside air temperature must change less than 2F to maintain comfort.*

The panel temperature must change as soon as the exterior conditions cause a change in the interior conditions. Exterior conditions can be either immediate or delayed in their effect on the interior conditions. Immediate effects are (a) forced ventilation of untempered or partially tempered air, (b) infiltration, and (c) transmitted solar radiation. Delayed effects are (a) outside air temperature and (b) absorbed solar radiation.

As the immediate effects are increased in magnitude the panel has less time to change temperature, and the thermal capacity of the panel must be reduced. As the delayed effects are increased the panel has the same time as the structure to change temperature, and the thermal capacity can be proportionate to the thermal capacity of the structure. If the panel does not respond to the immediate and delayed effects in sufficient time (has excessive thermal capacity) the occupant will be uncomfortable. *In general, the panel must be able to respond as quickly as the occupant.*

An equation[2] which gives the change in inside air temperature to maintain ideal comfort for a change in outside air temperature is:

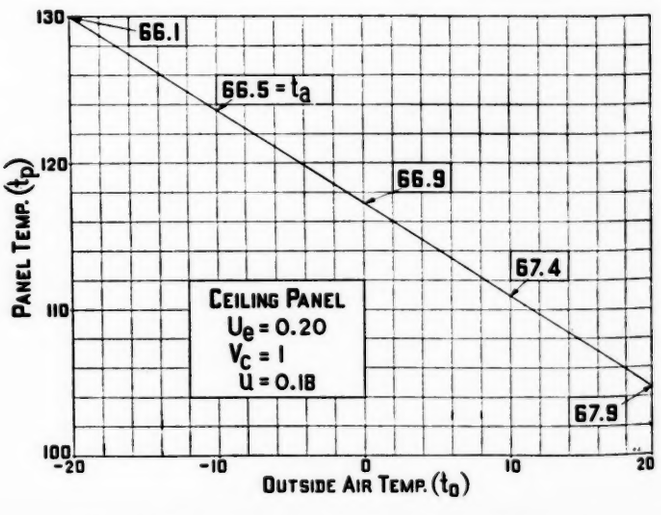


Fig. 1. Comfort conditions for a specific room.

[1]U. S. Steel Corporation Subsidiary.

*Numbers in parentheses refer to references listed in the bibliography at the end of this article.

[2]The derivation of this equation is given in the appendix.

$$\frac{dt_a}{dt_o} = \frac{0.018\,V_c\,M + DC_e v^2}{M(h_c + B) - D(A + h_c v^2)} \qquad (1)$$

where:

dt_a = change in inside air temperature, F

dt_o = change in outside air temperature, F

$\frac{dt_a}{dt_o}$ = rate of change of inside air temperature with respect to change in outside air temperature

V_c = specific ventilation rate, cu ft per (sq ft) (hr) (see appendix)

C_e = equivalent conductance of room (1, 2) (inside surface to outside air) Btu per (hr) (sq ft) (F)

$$= \frac{1.65 \times U_e}{1.65 - U_e}$$

U_e = equivalent over-all coefficient of heat transmission (1, 2) (inside air to outside air), Btu per (hr) (sq ft) (F) (see appendix)

v = fraction of total room area that is non-panel

u = fraction of total room area that is panel

0.018 = factor converting ventilation volume ratio to weight ratio

h_c = convection film coefficient of heat transfer for air to unheated area, Btu per (hr) (sq ft) (F)

h_p = convection film coefficient of heat transfer for panel to air, Btu per (hr) (sq ft) (F)

h_r = radiation coefficient of heat transfer for panel to non-panel area, Btu per (hr) (sq ft) (F)

$M = h_r + v(h_c + C_e)$

$A = h_r u + h_c v + C_e v$

$B = h_p u + h_c v + 0.018\,V_c$

$D = h_c - h_p$

The parameters for ceiling, floor, and wall are:

Ceiling

$M = 1.06 + v\,(0.8 + C_e)$

$A = 1.06\,u + v\,(0.8 + C_e)$

$B = 0.4\,u + 0.8\,v + 0.018\,V_c$

$D = 0.4$

Floor

$M = 1.04 + v\,(0.8 + C_e)$

$A = 1.04\,u + v\,(0.8 + C_e)$

$B = 1.1\,u + 0.8\,v + 0.018\,V_c$

$D = -0.4$

Wall

Since $D = 0.7 - 0.7 = 0$ for a wall panel

$$\frac{dt_a}{dt_o} = \frac{0.018\,V_c}{2\,h_c + 0.018\,V_c} = \frac{V_c}{77.7 + V_c}$$

Once the panel size has been determined (2), all variables on the right side of Equation (1) are known and the inside air temperature—outside air temperature ratio (dt_a/dt_o) can be calculated. The parameters for Equation (1) vary for ceiling, floor, and wall because of changes in the heat transfer coefficients. Fig. 2 shows that ceiling panels cause the maximum variation in inside air temperature for given variation in outside air temperature, but this ceiling variation

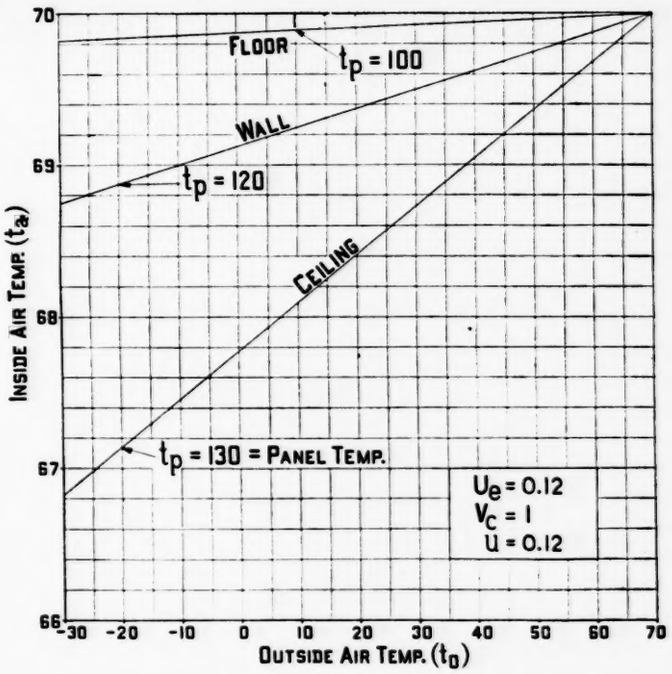


Fig. 2. Comfort conditions for various panel locations.

is slight. The floor has the minimum dt_a/dt_o ratio because it is the best convector of the three panels. Since the ceiling panel represents the least advantageous case for the argument of this article, all examples and figures are based on ceiling panel performance.

Limit panel temperatures are shown in Fig. 2, 3, and 4 as 130F, 120F, and 100F for the ceiling, wall, and floor respectively. These limits are purely arbitrary and are plotted to indicate panel temperature variation from a minimum of 70F for the case stated in the figures.

To demonstrate the absolute effect of dt_o on dt_a the maximum daily outside temperature variation can be assumed to be 30F and the maximum seasonal variation to be 100F (— 30 to + 70).

For example, in a room having an equivalent over-all coefficient of heat transfer, U_e, of 0.84, a specific ventilation rate, V_c of 1, and a ceiling panel (this is average for a well insulated residence not having excessive glass exposure), the parameters for Equation (1) become:

$D = 0.4$

$A = 0.902$

$B = 0.778$

$M = 1.856$

$u = 0.10$

then

$$\frac{dt_a}{dt_o} = \frac{0.018 \times 1.856 + 0.4 \times 0.084 \times 0.81}{1.856\,(0.8 + 0.778) - 0.4\,(0.902 + 0.8 \times 0.81)} = 0.026$$

For a daily outside air temperature change, dt_o of 30F, the inside air temperature change, dt_a, is 0.78F and for a seasonal change of 100F, dt_a = 2.6F to maintain ideal comfort. Since most on-off thermostats have ± 1F accuracy, this example room will be adequately controlled for comfort for daily and seasonal

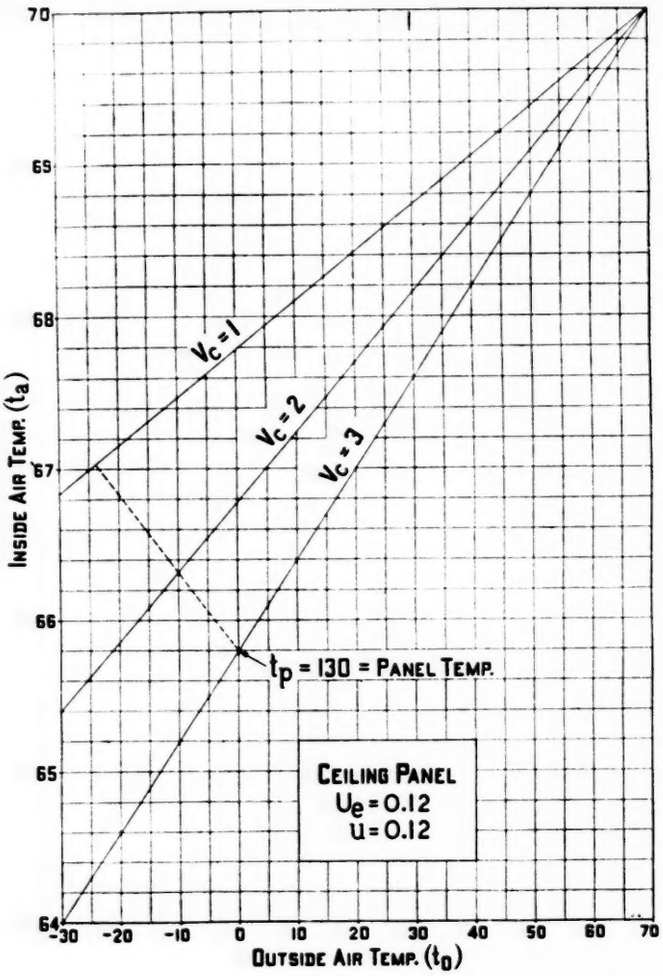


Fig. 3. Comfort conditions for variable ventilation rates.

changes by an on-off thermostat. Even for a room with $U_e = 0.24$, $V_c = 2$, a ceiling panel with small thermal capacity will respond to comfort conditions with inside air temperature control. In this instance, $dt_a = 0.0631\ dt_o$; therefore, for a daily change of $dt_o = 30$F, $dt_a = 1.89$F, and for a seasonal change of $dt_o = 100$F, $dt_a = 6.31$F. For this extreme case, the occupant would probably have to make at least two adjustments of the thermostat during the season. Equation (1) is based on 70F inside air temperature and 70F average surface temperature; these interior conditions will allow about 400 Btu per hr body heat loss (5). Due to physiological changes and disturbances, however, the occupant may have temporary deviations from the usual comfort conditions. An example of a temporary variation is the "chilliness" one experiences due to the common head cold. It is not uncommon for the comfort requirements of occupants to change several times during the heating season; therefore, the several settings of the thermostat indicated by the dt_a/dt_o ratio would probably be less than those required by physiological changes.

A graphical demonstration of the influence of ventilation rate on the dt_a/dt_o ratio is given in Fig. 3. A value of 3 for V_c is equivalent to 1.5 air changes per hour in a room $8 \times 13 \times 20$ ft or to two air changes per hour in a room $8 \times 8 \times 10$ ft. Fig. 3 shows that the dt_a/dt_o ratio increases with increasing ventilation, but in the worst case, $V_c = 3$, the inside air temperature only drops 6F for a drop of 100F in the outside air temperature for the case of Fig. 3.

Fig. 4 shows that the equivalent over-all coefficient of heat transmission, U_e, influences the dt_a/dt_o ratio in the same manner as ventilation, V_c. This seems logical since an increase in U_e or V_c is an increase in the heating load. An average value for U_e is about 0.12 Btu per (hr) (sq ft) (F), and a U_e of 0.20 is quite high. A room having a U_e of 0.20 has dimensions $8 \times 12 \times 8$ ft, with walls exposed on three sides, with one-quarter of the exposed area single pane glass, with a coefficient of heat transmission, U, of 0.20 for walls, with a heated basement below, and with a full ceiling panel. A value of $U_e = 0.20$ shows a dt_a/dt_o ratio of 0.046F for the case of Fig. 4.

The question of size of the panel affecting the use of an on-off thermostat is answered in Fig. 5 where panel areas of 10, 15, and 20% of total room area have been taken with $U_e = 0.12$ and $V_c = 1$; it is readily apparent that the size of the panel has negligible effect on the dt_a/dt_o ratio.

The purpose of this paper has been to show that an on-off air thermostat will provide ideal comfort for many radiant heating installations. When the structure has a very high ventilation rate with untempered air, or when the panel has disproportionate thermal capacity, a control must be employed which anticipates a change in the heating load. In the event that the V_c value approaches 3 cu ft per (sq ft) (hr) then thermal capacity of the panel must be low enough to permit the panel temperature to respond very quickly; otherwise, the panel thermal capacity can be propor-

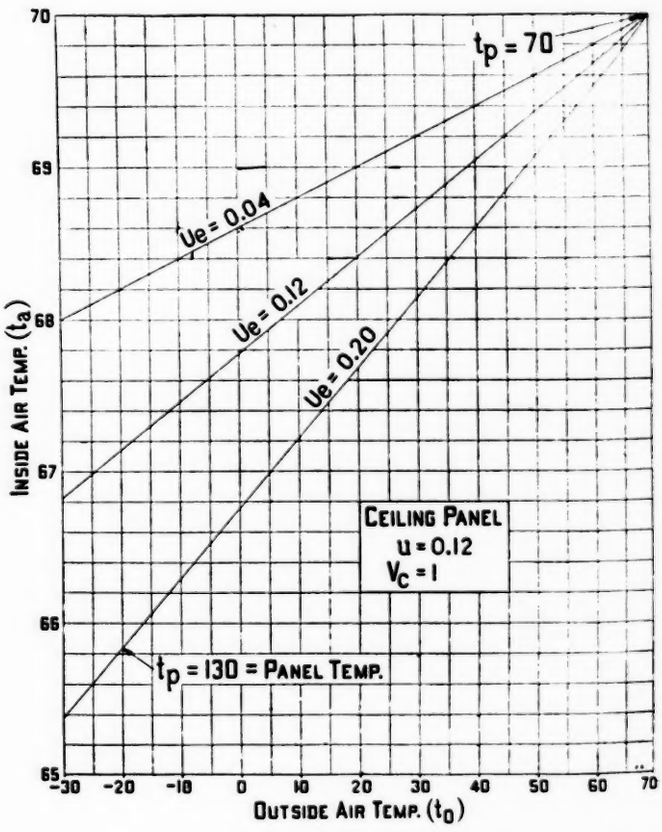


Fig. 4. Comfort conditions for variable equivalent conductance (U_e)

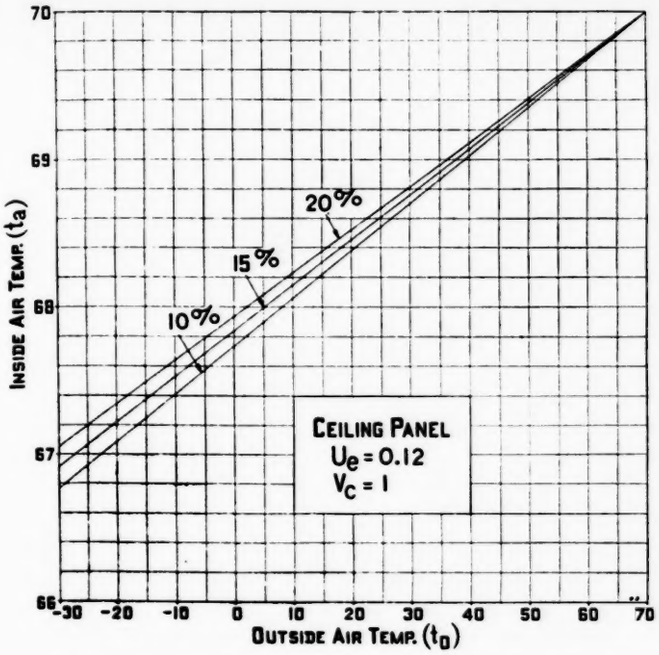


Fig. 5. Comfort conditions for variable panel size.

tionate to the structure thermal capacity. Actual test data, for a limited range, corroborates this theory (4).

The graphs show that ventilation rate and the equivalent over-all coefficient of heat transfer are the most influential variables on the dt_a/dt_o ratio for a specific panel location, but of the three possible panel locations the ceiling panel requires the greatest change in inside air temperature for a given outside temperature change. The effect of panel size can be neglected when considering comfort control for radiant heating. The panel temperature must always answer the demand of the inside air temperature thermostat, but a large or small panel will perform almost the same if the panel temperature is uniform and if the boiler water temperature can change fast enough to meet the changes in load to be expected during the heating season. Generally, the proper sizing of the boiler will assure adequate response to load.

Appendix

Derivation of Equation

The equation for dt_a/dt_o was derived from three basic heat balances (3):

$$t_a + ut_p + vt_e = a \qquad (2)$$

$$h_c vt_a + h_r ut_p - At_e = -C_e vt_o \qquad (3)$$

$$-Bt_a + h_p ut_p + h_c vt_e = -0.018 V_c t_o \qquad (4)$$

First multiply Equation (2) by h_c and subtract from it Equation (3) then

$$ut_p D = (ah_c + 0.018 V_c t_o) - t_a (h_c + B)$$

which may be written

$$ut_p = \phi - \theta t_a \qquad (5)$$

where

$$\phi = \frac{ah_c + 0.018 V_c t_o}{D}$$

$$\theta = \frac{h_c + B}{D}$$

Next multiply Equation (2) by A and Equation (3) by v and add to get:

$$ut_p (A + h_r v) = (aA - C_e v^2 t_o) - t_a (A + h_c v^2)$$

which may be written

$$ut_p = a - \beta t_a \qquad (6)$$

where

$$a = \frac{aA - C_e v^2 t_o}{A + h_r v}$$

$$\beta = \frac{A + h_c v^2}{A + h_r v}$$

Equate (5) and (6) to obtain

$$\phi - \theta t_a = a - \beta t_a$$

$$t_a = \frac{\phi - a}{\theta - \beta} \qquad (7)$$

By differentiating t_a with respect to t_o equation (7) becomes

$$\frac{dt_a}{dt_o} = \frac{0.018 V_c M + DC_e v^2}{M (h_c + B) - D (A + h_c v^2)} \qquad (1)$$

Definition of Equivalent Over-all Coefficient of Heat Transmission, U_e

The equivalent over-all coefficient of heat transmission, U_e, is defined as the total heat loss by conduction divided by the non-panel surface area of the room.

$$U_e = \frac{U_g A_g \Delta t_g + U_f A_f \Delta t_f + U_c A_c \Delta t_c + U_w A_w \Delta t_w + U_i A_i \Delta t_i}{(A_g + A_f + A_c + A_w + A_i)\ (t_a - t_o)}$$

Where:

Subscripts are: g for glass, f for floor, c for ceiling, w for exposed walls, i for walls not losing heat, a for inside air, and o for outside air.

U = coefficient of heat transmission, Btu per (hr) (sq ft) (F)
A = area of surface, sq ft
Δt = temperature difference, F, between inside air and air on opposite side of section denoted by the subscript
t = temperature, F

Definition of Specific Ventilation Rate, V_c

The specific ventilation rate, V_c, is defined as the volume per hour of untempered air that passes over each square foot of inside surface of the room.

$$V_c = \frac{V \Delta t'}{A_t \Delta t}$$

where $\Delta t' = t_a - t_s$, F
$\Delta t = t_a - t_o$, F
A_t = total surface of room, sq ft
V = volume rate outside air, cfh
t_s = temperature of tempered air, F

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A Review of British Experiments in Domestic Heating

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Three papers concerned with British experiments in domestic heating have recently appeared in the British technical press: two of these are in journals not generally available in America; the third was in the Journal of the Institution of Heating and Ventilating Engineers. The review and extracts which follow have been prepared with the idea of bringing to American heating engineers some idea of the problems being encountered in post-war development in Britain, and the steps taken to develop scientific data to guide the various authorities concerned with plans to improve domestic heating and reduce the consumption of coal for domestic heating, whether that coal is used directly in the home or is used indirectly in the form of gas or electricity.

THE effect of present methods of domestic heating on coal consumption and atmospheric pollution was reviewed by Dr. A. Parker, director of fuel research, before the Institute of Fuel. Dr. Parker cited the results obtained in terms of comfort and the efficient use of the nation's fuel resources. When coal was relatively cheap and abundant in Britain it was used wastefully, the average inland consumption of coal from 1893 to 1922 being about 5 (short) tons per person. In the period between 1923 and 1945 this average dropped to 4¼ tons due to a measurable increase in over-all efficiency in the *industrial* use of coal. Domestic use for heating and cooking in 1938 averaged about 1.4 tons per person.

This amount of fuel, if used at 100% thermal efficiency, Dr. Parker said, would have provided about 400 therms (40 million Btu). Corresponding figures for the United States show that the fuel used for domestic purposes could have provided about 430 therms. From these figures it is obvious that domestic fuel burning appliances used in this country are much more efficient than those used in Britain. They also show that it should be possible to provide a pre-war standard of comfort in British dwellings with a much lower consumption of fuel, or preferably to improve conditions with no more, and possibly even less, fuel.

Efficiency of Use of Fuel

To obtain accurate figures of the efficiency with which fuels are used in occupied houses with different family requirements, twenty-eight houses, equipped with several types of heating installations and constructed to give different degrees of insulation in walls, floors, roofs, and windows, are under test at the Building Research Station. Some of the results obtained are given in the other two papers.

Rough estimates of fuel efficiency *under average household conditions*, rather than under so-called test-bench conditions, showed that only about one-fifth of the heat value of the raw coal consumed in ordinary household use was usefully employed; four-fifths were lost and greatly increased atmospheric pollution. This figure of 20% refers to conditions of use over long periods of many hours each day. For short periods of intermittent use, gas and electric appliances may be more efficient and no more costly than solid fuel, and have the advantage of greater convenience and cleanliness. Dr. Parker suggests that in domestic heating systems in use in the United States and Canada, over-all working efficiencies of 40 to 50% are obtained.

Residents of Great Britain have long been accustomed to the open fire which serves as a center in the group of family and friends in the leisure hours. The change-over to closed stoves is not an easy matter, and, as Dr. Parker points out, if there *had* been a great change-over, the demand for smokeless fuels (anthracite, low volatile coal, or coke) in graded sizes would have greatly exceeded the supply.

Heat Conservation in Small Houses

New designs of open fires which burn bituminous coal more efficiently and with less smoke are now available; some of these can be closed with a cover to allow slow continuous burning during the night, or as required. Though more efficient than the traditional open fire, they are not so efficient as the best of the modern openable stoves and closed stoves. In developments now under way there is said to be close cooperation between the manufacturers, industrial research organizations, and the Fuel Research and Building Research Stations. As many are aware, British government officials as well as British industrialists have already made extensive studies of American methods of domestic heating and their possible application in the improvement of domestic heating in Great Britain.

Fig. 1. Floor plan of experimental house.

Fig. 2. Eight experimental houses at Building Research Station.

A. F. Dufton of the Building Research Station reported, in the August issue, Vol. 15, No. 145, of the Journal of the Institution of Heating and Ventilating Engineers, on studies made during the 1945-46 heating season in eight houses built for the joint purpose of research in house construction and full-scale tests of the heat requirements of houses insulated to different standards.

The general plan of the experimental houses, which have flat roofs, is shown in Fig. 1. Full structural details are given in the paper. Table 1 shows the calculated heat transmittance factors for the four types of houses in which tests were made.

Table 1 — Thermal Transmittance of Various Walls

Construction Unit	House Insulation Standard A	B	C	D
	Heat Transmission, Btu per (hr) (sq ft) (F)			
External walls	0.30	0.25	0.20	0.15
External walls, living room	0.30	0.20	0.15	0.10
Windows	1.0	1.0	1.0	0.5
Windows, living room	1.0	1.0	0.5	0.5
Ground floor	0.35	0.20	0.15	0.10
Roof and top-floor ceiling	0.56	0.30	0.20	0.15

Grade A represents the ordinary pre-war British house; Grade C represents the standard recommended by the Egerton Committee, whose report to the British government was used in formulating policy on housing and fuel utilization. The Grade B houses have lower standards, and the Grade D houses higher standards of insulation, than the Egerton Committee recommended.

The heating system installed was selected as an experimentally convenient example of an installation using solid fuel; the heating appliances do not need constant attention. Background heating is provided by embedded ceiling panels in the living room and the parlor, which serve also as floor panels for the two main bedrooms; and the living room is "topped up" by an electric fire. (*Topping-up* is a British term for the use of auxiliary heating to handle peak or localized loads.) Dufton says that, "As calculations indicated that the item for topping-up the living room would exceed that for the whole of the background heating . . . it was decided to include experiments in two more houses—one Grade A and the other Grade C—in order to ascertain whether it would be advantageous to eliminate the topping-up and to warm the living room solely by the central heating installation." In these houses the ceiling panels serve to keep the living rooms comfortably warmed and to provide background warmth in the parlor and bedrooms.

A thermostatically controlled magazine boiler, using small sizes of anthracite, was installed in the kitchen (See Fig. 1). The room thermostat operated a fan which supplied air to the fire and promoted vigorous combustion; otherwise the rate of combustion depended on the natural draft of the chimney. These boilers showed on test a mean efficiency of about 80%, irrespective of load. The boiler heated a hot-water tank in the linen cupboard indirectly and, through a specially designed heat-interchanger, which served as a towel warmer in the bathroom, supplied hot water to the panels. The report stated that in order to utilize heat which would otherwise be lost, a duct was provided around the boiler flue-pipe and this served to supply heated air to the landing on the first floor.

Eupatheostatic Control

To provide the ventilation standards recommended in the Egerton Report, louvers were installed above the doors to the living room, parlor and the three bedrooms. These admitted air from the hall and landing; the air was withdrawn from each room by a flue having a cross-sectional area of 30 sq in. and suitable for a gas fire. The main ventilation intake was via the tool-shed through a grille into the hall.

Fig. 3. New magazine boiler.

Since an ordinary room thermostat is relatively insensitive to the radiant heat from an electric fire, the warming of the living room was controlled by a eupatheostat. This is a warmed instrument which simulates the heat losses of a human being under various comfort conditions; it is responsive to the dry bulb temperature of the air, to air movement and to radiation from hot or to cold surfaces.

In the two houses mentioned above the eupatheostat controlled the flow of hot water through the ceiling panels by means of a motorized valve. In the other four houses, the eupatheostats switched electric fires on or off to maintain an *equivalent* temperature of 65F.

Each week in each house the equivalent of 250 British Imperial gallons (2500 lb) of hot water heated from 50F to 140F was drawn off (225,000 Btu per week). A cooking load equal to 4 KW per day was also used in each house. The houses were unoccupied except when the observers were collecting data.

Discussion of Experimental Results

The average daily minimum temperature for all the rooms of each house for the five months November 1, 1945, to March 31, 1946, ranged from 56F to 59F; the average mean temperature of each house was about 1.5 degree higher. For the two houses where the living room was heated solely by the ceiling panels, the average daily minimum temperatures were about 65F in the house with no insulation, and 66F in the house with the Grade C standard insulation, respectively. No details are given on the range of relative humidities experienced. (To American readers all these temperatures will appear low, but under British outdoor weather conditions they are a decided improvement over pre-war standards of domestic heating.)

Insulation—Fuel savings due to insulation, calculated on the basis that the house having thermal transmittance values given under *A*, Table 1, was the datum line, were as follows: with insulation to give values under *B* (Table 1) the fuel savings were 12.7%; for conditions to give *C* (Table 1) 25%; and for insulation to give *D* (Table 1) 43%.

Topping-up — The report states that the tests made to see whether it would be advantageous to eliminate topping-up by electric fires clearly showed that it was more advantageous to use the central heating installation alone. In view of the recommendations made in some British reports, this appeared to be an important finding. However, later tests in the houses, when they were occupied, failed to confirm these findings.

Economical Utilization of Fuel—Tests in the unoccupied houses also served to show that it was quite practicable to heat detached uninsulated houses with less fuel than was estimated in the Egerton Report and that by the use of adequate insulation substantial yearly savings could be made. (Nothing is said concerning increased comfort due to better insulation of the walls and windows.)

Measured Versus Computed Heat Requirements

A comparison was made of the computed heat requirements of the six houses and the actual heat inputs, determined from the quantities of fuel consumed or heat supplied and the over-all efficiency of utilization. The computed heat requirements were obtained from the data given in Table 1, the details of construction, the average indoor temperature for each room for each day of the test period, and the average outside temperature for each day. The heat losses due to ventilation were estimated on the following basis: living rooms, 2400 cu ft per hr; bedrooms, 600 cu ft per hr per person; kitchen, 100 cu ft per hr; halls and passages, one air change; bathroom and toilet (w.c.), two air changes.

Table 2 — Comparison of Measured Versus Computed Heat Requirements for Period Nov. 1, 1945 — Mar. 31, 1946

Standard of Insulation (See Table 1)	Millions of Btu for 5 Months		Excess of Heat Input Over Calculated Requirements
	Calculated	Experimental	
Background heating plus topping-up			
A	81.7	73.2	— 10%
B	63.2	66.3	5%
C	56.6	57.1	1%
D	46.1	45.5	— 1%
All central heating, no topping-up			
A	93.6	78.3	— 16%
C	64.8	59.5	— 8%

The summary of these results is given in Table 2 condensed from a more comprehensive and detailed list in the paper.

It will be seen that in the houses with the minimum insulation (A), equivalent to the ordinary pre-war British home, the heating appears to have been much more economical than the calculated requirement.

It is unfortunate that no figures are given comparing the actual heat input with the calculated heat requirements based on indoor and outside design temperatures and degree days. Such figures would have been interesting since heating requirements are generally computed on this or some similar basis. Many of the claims for excessive fuel savings accredited to panel heating, insulation, storm windows, weatherstripping, etc., are based on figures for actual fuel consumption over a certain period, with certain definite average indoor and outdoor conditions, as compared with estimated fuel requirements based on indoor-outside conditions which may not closely duplicate the actual conditions at all.

Summer Temperatures in Unheated Houses

Data collected during part of the summer in all the rooms of five unheated houses showed that the average maximum temperature of the various rooms of each house measured at 9:30 a.m., 1:30 p.m., and 4:00 p.m. was approximately equal to the maximum shade temperature. The average *mean* temperature was approximately 7F higher than the *mean* shade temperature. Over a three-week period in midsummer a house with a pitched roof was nearly three degrees cooler than a house of the same grade with a flat roof. The standard of insulation appeared to have very little effect.

Heating Studies in Occupied Houses

In the October 1947 issue of the Journal of the Institute of British Architects, P. Mason, also of the Building Research Station, reported the results of tests made during the 1946-47 heating season when the houses were occupied. As the author pointed out, "A straightforward comparison of heating costs between two houses does not merely represent economies due to improved insulation, but reflects the relative thermal habits of the occupiers. The expression 'thermal habits' embraces all factors relevant to house heating which are under the *personal* control of the occupiers, e.g., room temperatures, ventilation caused by opening windows, amount of cooking, hot water usage, etc. These habits are not relevant to the main aim of the experiment, and in order to obtain the desired comparison the fuel costs must be reduced to correspond to equivalent thermal habits, of which ventilation is one of the most important. Ultimately, when the above plans have been completed, the total heat input to each house will be associated with measured values of temperature, ventilation, hot water consumption, etc., and a statistical treatment can then be used to compare, between any two houses, the heat inputs corresponding to the average value of the habit factors, and to provide at the same time an estimate of the reliability of the result."

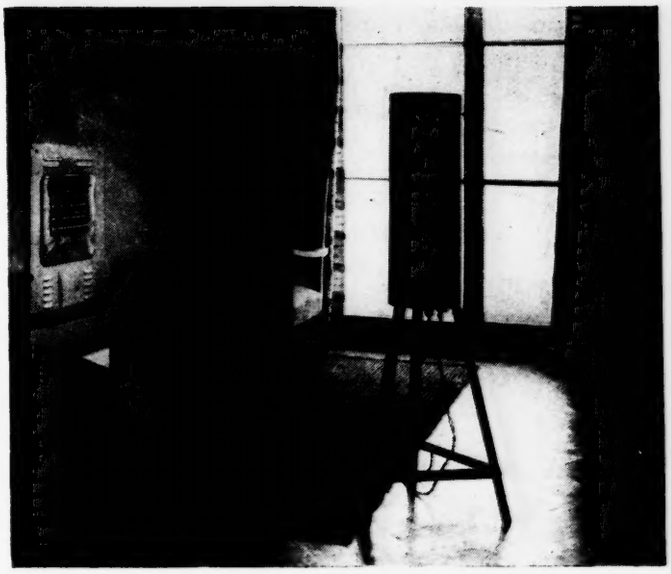

Fig. 4. Eupatheostat and electric wall fire.

Measurements by Tenants and by Automatic Recorders

In the unoccupied phase, internal temperatures were obtained from daily readings of maximum-minimum thermometers hung in nine positions in each house at a height of 5 ft from the floor. When the houses were occupied resistance thermometers were installed; temperatures were recorded by remote-reading automatic recorders located in an instrument hut erected at the rear of the six test houses. The true average temperature could then be obtained from the readings taken from each location once every ten minutes rather than from the average of the maximum and minimum room temperatures.

For one whole month daily comparisons were made of the tenants' observations of the maximum and minimum temperatures of each room and of the true values as shown by the recorder charts. An examination of over 2000 values of the differences between the estimates of average room temperature given by the tenant and by the recorder showed that the 95% Confidence Limits varied from $\pm$ 2.2F to $\pm$ 2.9F for the daily averages and $\pm$ 0.8F to $\pm$ 1.1F for the weekly averages. (To say that the 95% Confidence Limits are $\pm x$ from the average implies that out of 100 observations by tenants only five may be expected to err by more than plus x or less than minus x.) It may be rather surprising to some to find that the tenants' weekly average came within 1 degree of the average from the recorded values. The author says in the conclusions, "Investigators of conditions in occupied houses may place a reasonably high degree of confidence on simple physical observations made by the occupiers."

Climate

Measurements were made of outside air temperatures, wind speed and direction, sky radiation, and

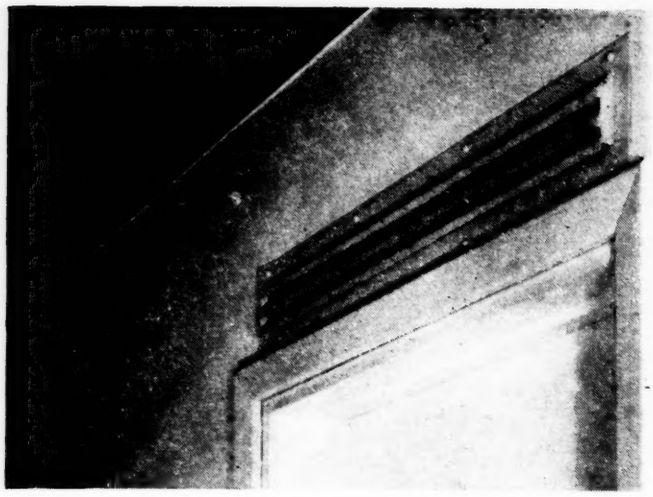

Fig. 5. Louvers over bedroom doors.

rainfall. The report says that arrangements are in hand for recording the exchange of radiation between a house and the sky. (Generally speaking, too little attention has been paid to this in the past, but it may be quite significant.)

Heat Balance – Heat Loss Due to Ventilation

The paper goes into an experimental analysis of the heat balance equation at some length and shows that the values for the ventilation rate could be significantly correlated with the corresponding weekly values of average wind speed. The seasonal totals of heat losses due to conduction, ventilation, and hot water run to waste are given in Table 3.

house of pre-war insulation, even with a radiant heating system in which the air is only indirectly heated, the ventilation loss amounts to one-sixth of the total; with the more common hot water 'radiators', the loss may exceed a quarter of the total. One of the main advantages claimed for the radiant panel by its advocates is based on the supposition that in practice it will involve a smaller ventilation heat loss than the ordinary radiator system. The present experiment is too small in scale to serve as a test of this claim. . . . Secondly, that as more attention is paid to improving the insulation, the relative importance of ventilation as a source of heat loss increases; thus in a really well-insulated house the ventilation loss may account for as much as half of the entire heat input. . . . "

Topping-up

In the report on the unoccupied houses it was stated that the results from two houses "clearly showed that it was more advantageous to eliminate topping-up by electric fires and warm the living room solely by the central heating installation (ceiling panels)". When these houses were occupied it was found, however, that the tenants used a certain amount of electricity for topping-up. Larger studies are evidently needed before any definite conclusions can be drawn on this point which is of great interest in studies to show how British post-war houses shall be heated.

Long-Range Program

The experiments reported have been planned on a long-term basis and further results will be watched with interest. Future plans call for an intensive study, both practical and theoretical, of the heat losses caused by ventilation and further investigation of the effects of the climatic variables on heat requirements.

Table 3 – Percentages of Heat Lost by Conduction, Ventilation, and Hot Water Waste

Insulation Grade	House No.	Type of Heating	Window Opening	Percentage of Total Heat Loss by:		
				Conduction	Ventilation	Hot Water
A	8	Hot Water Rads.	Medium	61	35	4
	1		Medium	69	26	5
	4	Ceiling Panels	Medium	81	16	3
	3		Medium	79	18	3
B	5	Ceiling Panels	Low	75	21	4
C	7	Ceiling Panels	High	58	39	3
	2		Medium	73	25	2
D	6	Ceiling Panels	High	48	48	4

An indication of tenant habit can be deduced from the records of window opening.

As the paper says, "This table does not illustrate any novel truths, but does serve to emphasize two points of architectural importance. Firstly, that in a

Corrosion of Underground Steam Line Supports

LEO F. COLLINS, F. J. SCHLACHTER, and G. D. WINANS
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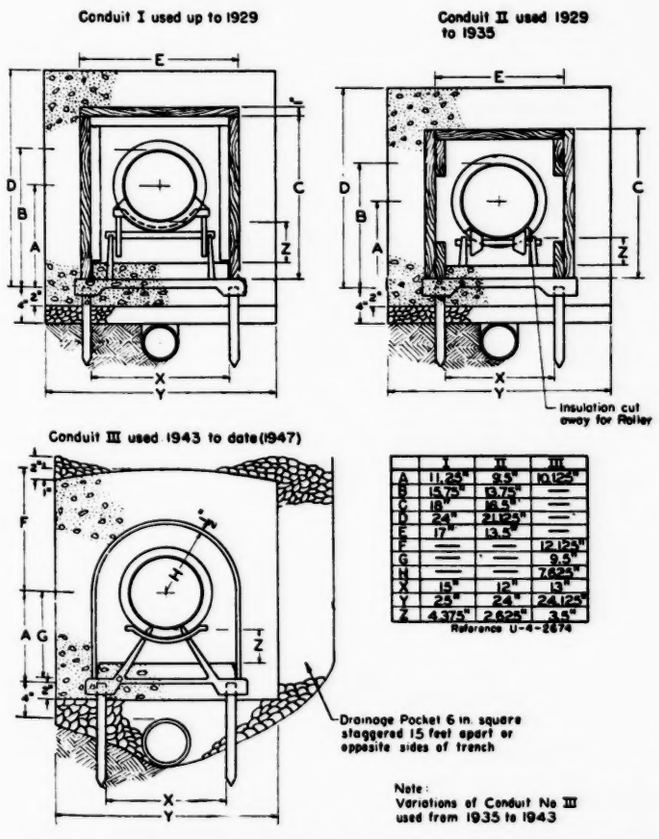
This is a report of corrosion tests of 16 metals at seven different sites along the 40 miles of underground steam lines of the Detroit Edison Co. The investigation was conducted as part of a search for an economical method of supporting pipes in conduits of the Detroit district heating system. This article is based on a paper presented at the annual meeting of the National District Heating Association. Other papers presented at this meeting are abstracted briefly in the News section, page 114.

IN the commercial districts of large cities, virtually all utility services are distributed via underground systems. Thus, networks of cables and pipe lines coexist beneath streets and alleys. Seldom are they buried in true soils, but rather in chance mixtures of soils, sand, gravel, and clay. Invariably the surrounding earth is moist. At times and at chance locations it is saturated with water. Stray electric currents find such metallic systems convenient conductors. All of these factors promote corrosion. As a result, the operation of such systems is always faced with the threat of failure from corrosion.

The installation of lead-sheathed cable, in vitrified or other semi-insulated conduits, has done much to reduce the frequency of failures in communication and electrical transmission systems. The development of protective coatings has likewise made available a means for shielding cold piping systems. In rural areas cathodic protection has been shown effective but in metropolitan areas it would seem to have limited possibilities. But, none of these expedients appears practical in the case of steam lines, principally because of the high temperatures involved.


Conduit I used up to 1929
Conduit II used 1929 to 1935
Conduit III used 1943 to date(1947)
Insulation cut away for Roller
Drainage Pocket 6 in. square staggered 15 feet apart on opposite sides of trench
Note:
Variations of Conduit No III used from 1935 to 1943
Reference U-4-2674

	I	II	III
A	11.25"	9.5"	10.125"
B	15.75"	13.75"	—
C	18"	16.5"	—
D	24"	21.125"	—
E	17"	13.5"	—
F	—	—	12.125"
G	—	—	9.5"
H	—	—	7.625"
X	15"	12"	13"
Y	25"	24"	24.125"
Z	4.375"	2.625"	3.5"

Fig. 1. Development of steam main conduit 1909 to 1947. Sketches based on 8-in. pipe conduit.

Fig. 2. Typical failure of bracket and roller on 16-in. steam main; installed 1928—removed 1947.

For these reasons, and because of the meager amount of information available in the technical literature, it was decided late in 1945 to conduct corrosion studies in the underground steam system of the Detroit Edison Co. in the hope that (1) a metal more suitable than cast iron for steam line supports would be discovered and (2) that the basic causes for corrosion failure would be revealed.

This report presents the results of measurements made at seven different locations where the resistance to corrosion of 16 different metals was compared, together with other data that attest the probable causes of exterior corrosion of steam lines and their supports.

Nature of the Problem

In the steam distribution system about 2½ miles of pipe are housed in horseshoe shaped tunnels. The latter are of such dimensions as to permit inspection of the lines, and their supports, and maintenance. Virtually no corrosion failures have occurred in such construction, but an appreciable amount of main-

tenance work has been made necessary due to generalized corrosion.

40 Miles of Conduit

The remainder of the system, some 40 miles, is housed in conduit construction of the types indicated in Fig. 1. In such cases inspection is impractical and the ravages of corrosion become known only when failures occur. That such failures are of real significance can be appreciated when it is pointed out that the average cost of repairing one corrosion fault is approximately $750; that over-all corrosion imposes a maintenance cost of approximately $2,000 per year per mile of underground steam system construction.

Fig. 2 depicts a type of failure common to the type of construction noted as II in Fig. 1. From Fig. 2 it is clear that the support is subjected to generalized attack to an extent likely to "freeze" the roller. Frequently a hole appears in the steam pipe at the point of contact with the roller, but whether the hole results from movement of the pipe over a stuck roller, or from corrosion, or both is still a matter of speculation.

While the design identified as III in Fig. 1, precludes failures of pipe lines for either of the reasons noted above, the supports and saddles may be vigorously attacked.

Causes of Failures

From Fig. 1 it is apparent that neither steam lines nor their supports make intimate contact with the earth. Thus, the possibility of soil corrosivity being a controlling factor would appear to be remote. Moreover, studies made on gas and water lines throughout the city have failed, thus far, to show a satisfactory correlation between corrosion and the chemical quality of the soils.

Available data show clearly that the chemical composition of the cast irons used has been uniform, and that the cast iron used in recent years has not been of an inferior quality.

The design characteristics that have been cited as accelerators of corrosion are:

(a) Inadequacy of the underdrainage system promoting flooding of the concrete envelope;

(b) Inadequacy of air space (too small cross-section of conduit) curtailing ventilation and proportionately increasing air temperatures;

(c) Porosity and poor jointing of the concrete envelope permitting inleakage of ground water.

Underdrainage System: It would seem to be impractical to attempt to devise a drainage system to cope with flash storms or serious water main and sewer failures. Moreover, it seems unlikely that occasional flooding is an important factor provided that the pipe covering is not seriously damaged. If, however, inadequacy of the underdrain is responsible for water being constantly present on the floor of the concrete envelope, it most certainly is a controlling factor.

The design noted as III in Fig. 1 was adopted largely because it precludes the possibility of damming the water at the pipe support. In many of the failures uncovered with the other types of construction, the wood (which was used as the inside of the form for pouring the concrete envelope) was found to have rotted, moved down stream to the pipe support, where it effectively dammed the water flowing from the concrete envelope.

Air Circulation: It will be shown that corrosion of pipe supports is due, in most cases, to oxygen dissolved in water. The presence of water, in the liquid state, is therefore essential.

It seems unlikely that sufficient circulation could be induced, thermodynamically, to completely evaporate important amounts of water. Tests, with smoke, have indicated virtually no air circulation occurs in conduits. Moreover, since the quantity of water entering a conduit is a chance proposition, there would appear to be no practical basis for design to guarantee complete evaporation of water by means of air circulation.

Porosity of Concrete Envelope: The results of the present studies indicate that the amount of water which seeps into the concrete envelope is largely a matter of geography since it varies widely from place to place. They also indicate that for any given location the amount of precipitation (rain and snow) during

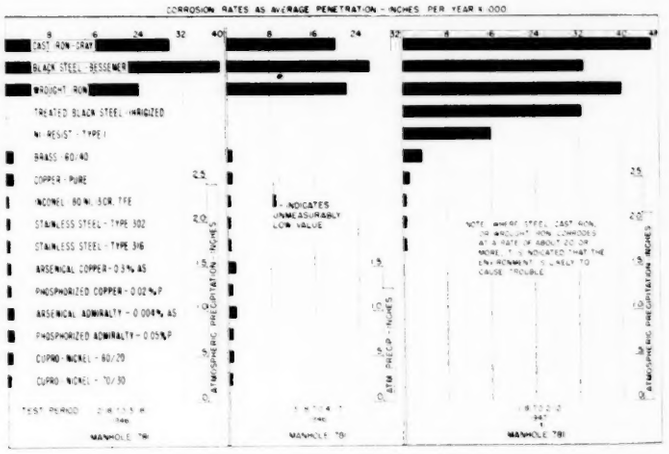

CORROSION RATES AS AVERAGE PENETRATION - INCHES PER YEAR x 000
CAST IRON - GRAY
BLACK STEEL - BESSEMER
WROUGHT IRON
TREATED BLACK STEEL (NIRIGIZED
NI-RESIST - TYPE I
BRASS - 60/40
COPPER - PURE
INCONEL - 80 NI, 13 CR, 7 FE
STAINLESS STEEL - TYPE 302
STAINLESS STEEL - TYPE 316
ARSENICAL COPPER - 0.3% AS
PHOSPHORIZED COPPER - 0.02% P
ARSENICAL ADMIRALTY - 0.004% AS
PHOSPHORIZED ADMIRALTY - 0.05% P
COPRO-NICKEL - 80/20
COPRO-NICKEL - 70/30
- INDICATES UNMEASURABLY LOW VALUE
ATMOSPHERIC PRECIPITATION - INCHES
TEST PERIOD
MANHOLE 78
MANHOLE 79
MANHOLE 78

Fig. 3. Representative readings of corrosion rates at one conduit test site showing precipitation during test periods.

a given period determines the amount of water that will enter the envelope.

In view of these facts, it is apparent that the concrete envelope while designed to afford a water barrier does not adequately perform this function and that ground waters rather than flood waters are the basic cause for most corrosion problems.

Test Technique

There are substantial reasons for believing that it is virtually impossible to devise a waterproof concrete envelope. There are equally as good reasons for believing that it would be unwise to attempt to use more than one design of pipe support for any given system.

For the latter, company engineers favor the one shown as III in Fig. 1. As such, they stipulate that it must not be made of tile, glass, or similar brittle materials.

In view of these specifications, a metal that is immune to attack under the prevailing conditions, not prohibitively expensive and that possesses adequate mechanical strength, and will readily yield to ordinary methods of fabrication would seem to be the only possibility. Accordingly a test technique was devised to search for such a metal.

Exposure trays were equipped with NDHA corrosion testers fabricated from what appeared to be "likely" metals. Subsequently the loaded trays were situated at seven test sites in such a manner as to reflect the corrosivity of the water which filters into the system at or near the test location.

Some specimens were also subjected to a standard salt spray and others were submerged in an industrial salt brine (NaCl) saturator.

Partial water analyses were made of samples collected at four test sites, and in one instance a complete analysis was made.

Corrosion rates measured at a conduit site, together with the amount of precipitation (rain and snow) during the test periods, are shown in Fig. 3; those measured in the brine tests are shown in Fig. 4.

Interpretation of Findings

Copper and its alloys are far less susceptible to attack by oxygenated waters than are cast iron, steel, or wrought iron. However, when substances other than oxygen control corrosion, copper and its alloys may corrode at a rate equal to or greater than that experienced by the common ferrous materials. Oxygenated water is not always the controlling factor in the tunnels. The following water analysis provides an index of the types of water responsible for corrosion at one tunnel location, and the data show that copper and its alloys were attacked by such water:

Complete Analysis of Most Highly Mineralized Water Encountered

Silica—SiO_2	33
Oxides—$Fe_2O_3 + Al_2O_3$	9
Calcium—Ca	198
Magnesium—Mg	84
Sodium—Na	—
Bicarbonate—HCO_3	480
Chloride—Cl	1750
Sulphate—SO_4	141
Total Dissolved Solids	3570
pH Value	7.2

All analytical figures, except pH, are parts per million by weight.

Test data also show that in conduits all the common ferrous materials were attacked at a much higher rate than copper and its alloys. This indicates that dissolved oxygen was the corrosion controlled factor. There is also an evident relation between corrosion, as experienced by the cast iron, wrought iron, and steel specimens, and the amount of atmospheric precipitation during the test period.

All of these data attest that in conduits inleakage of oxygen bearing ground waters is the controlling factor; that if inleakage does not occur corrosion is negligible. The wide variations in corrosion rates from place to place suggest that the concrete envelope is not uniformly efficient in excluding water.

It is clearly evident that none of the common ferrous metals differ in their resistance to corrosion. Thus, none may be relied upon for supports. The Ihrigizing of steel does not appear to improve its resistance to corrosion for the service in question.

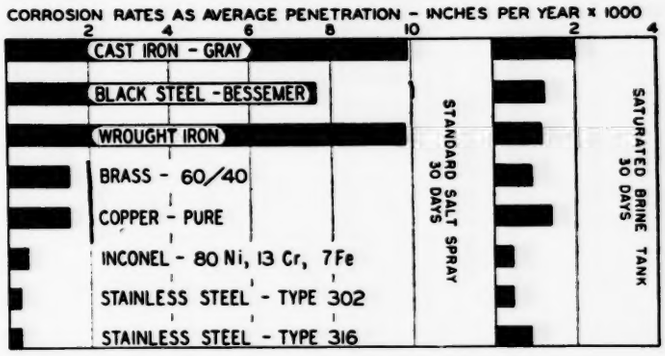


Fig. 4. Results of tests in salt spray and saturated brine.

That Ni-Resist (an alloyed cast iron) corrodes at about half the rate of gray iron is of little practical significance. It is still too susceptible to attack for the service in question, is considerably more expensive than cast iron, and is extremely difficult to machine.

Thus, of the 16 different materials tested, only Inconel and the stainless steels appeared to be sufficiently corrosion resistant to merit consideration. Since Inconel is considerably more expensive than stainless steel, and definitely more difficult to machine, the stainless steels were considered the logical choice.

The reputed susceptibility of stainless steel to attack by chloride solutions prompted the tests (Fig. 4) in the standard salt spray, and brine saturator. These results coupled with the water analysis data which indicate chloride concentrations below 2000 ppm, attest that, for the service in question, supports made of stainless steel should give satisfactory performance.

The water analyses indicate that only a small amount of salt used for de-icing the streets finds its way into the steam system. They also indicate that condensate and city water as well as ground water may be present. It is believed, however, that the quantity of water more than the origin of the water determines the rate of attack in conduit construction.

Design calculations show the stainless steel unit to have mechanical characteristics that equal or better cast iron units at a weight saving of about 55%. The combined weight of a cast iron bracket and saddle, for 8-in. pipe, is 29.4 lb. The combined weight of a stainless steel bracket and saddle, for 8-in. pipe, is 14.4 lb. At the prevailing price of the two metals, the stainless steel units will cost $9.35 as compared with $5.90 for the cast iron units. This will increase the cost of 8-in. pipe construction by 17 cents per ft. Such a cost increase will be more than justified if the predicted longer life of the supports is realized.

The Custom-Air System for

Air Conditioning Multi-Story Buildings

FEATURES of a central system and those of a unit system are combined in the Trane Custom-Air heating and ventilating method for multi-story buildings. It provides flexibility not possible with the central system so that conditions in individual rooms can be altered to meet individual needs of the occupants. This added flexibility is particularly valuable where some of the rooms have low sensible heat gain. Trane engineers have found that ventilation, humidification and dehumidification were best taken care of by a central system but that room temperatures were best controlled by room-units.

The Custom-Air system will cool and dehumidify in summer; heat and humidify in winter; ventilate and move the air the year around; provide the various phases of air conditioning as called for by the controls; will permit the occupant to select the temperature he desires.

Equipment for this type of system consists of a dehumidifier, sprays, a set of preheat and reheat coils, a heat exchanger, filters, and a fan for drawing in the outside air and discharging it to the spaces to be ventilated. Operating in conjunction with this equipment is the refrigerating plant using a Trane turbo-vacuum compressor which supplies chilled water to the dehumidifier coils, and a mixture of chilled water and recirculated water to the room units to be described later. This part of the design handles the complete air-conditioning of the building, including ventilation, humidification and dehumidification, so that it can be operated independently to supply the rooms with any or all of the features mentioned. Chemical dehumidifier and recooling coils, or a direct expansion system with precool and reheat coils can be used with equal results.

Part of the room sensible load must be removed by the ventilation air, the remainder to be removed by the room unit. The ventilating system provides latent cooling through proper dehumidification of the conditioned space, and it also humidifies where necessary. Because this ventilating air is usually below the room temperature during the cooling season, it can be used to offset heat gains in remote parts of deep rooms and spaces.

Two sizes of room units are available, one to handle 120-200 cfm and the other, 240-400 cfm. These units, located in each of the rooms to be served, provide heating and sensible cooling and also filter the recirculated air for the room served by the unit. Contained in each room unit cabinet is a belt-driven squirrel cage fan, small motor, water cooling and heating coils of the fin and tube type, permanent or throwaway type air filters, and an overload switch. Air is moved through the filter, coil, and directional flow discharge

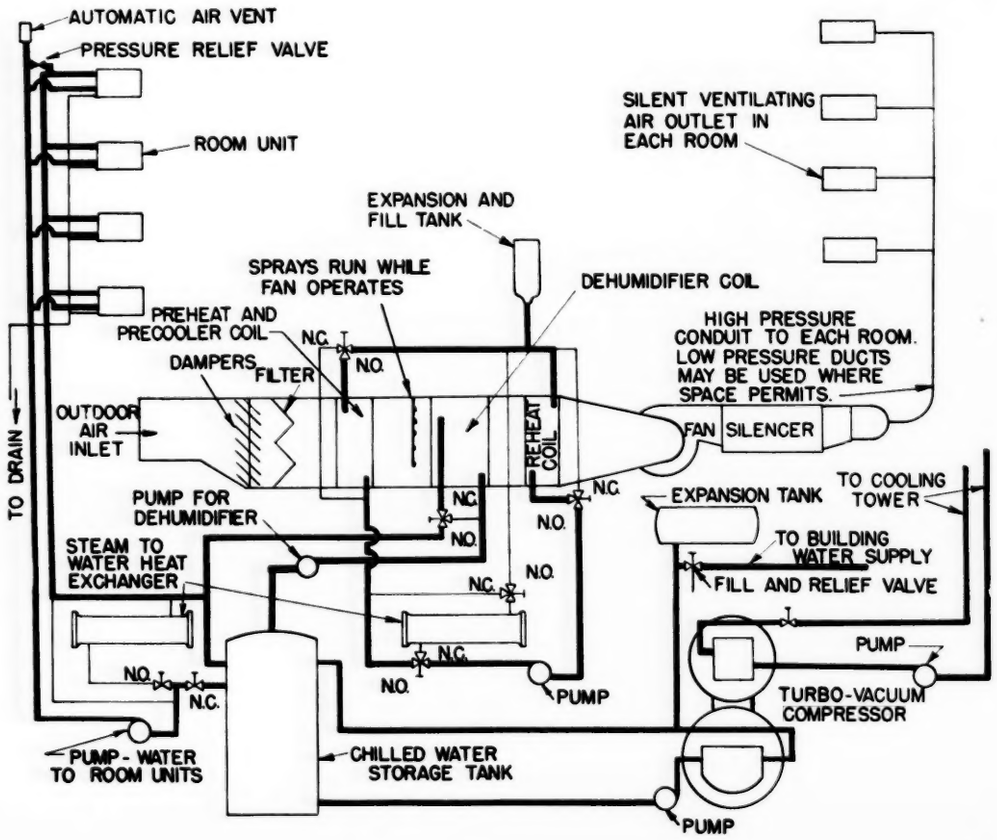


Fig. 1. Diagram of the components and valves of the Custom-Air system with piping circuit for summer cycle shown in heavy lines.

grille in the volume required. Speed of the fan can be varied by an adjustable pitch motor pulley. An emergency pan under the coils is connected to an emergency drain line to carry off any condensate that may form under severe operating conditions. The motor driven units operate independently of other motor driven units in the central system. They do not mix the air from other rooms.

Various operating cycles are possible. During the winter cycle, hot water is circulated through the coils in the room units. Quantity of water can be controlled by the room thermostats or by the manual valves, if desired. Ventilating air is introduced into the space at or near the temperature of the room. Sprays in the central plant equipment provide the proper amount of air humidification.

During the summer cycle, chilled water is supplied to the coils in the room units to remove the sensible heat. Quantity of water is controlled by the room thermostat. Ventilation air is introduced separately and at predetermined minimum temperature and low moisture content.

It is interesting to note what takes place between seasons and on rising outdoor temperature. Ventilation temperature remains constant at 75F. When the outdoor temperature reaches 75F, the ventilation air temperature is reduced to 60F. Water in the room unit coils is still warm enough to provide heat if necessary. With a further increase in outdoor temperature, water entering the coils is gradually chilled until full capacity for cooling is available. When the outside temperature falls, the cycle is merely reversed.

While either of these two cycles is in operation, fans in the room units operate continuously to draw room air into the units, through the filters, over the coils, and then out into the room. This contrasts with the induced type of combined central and unit systems which do not depend on fans but which rely upon the discharge of high pressure air into the room unit to create an induced flow of room air over the coils.

In summer the precool and reheat coils of the ventilation air system operate in a run-around cycle. In so doing, the coils take heat from the incoming outside air and transfer it to the cold dehumidified air leaving the dehumidifier coils for reheat purposes. During the winter cycle, the precool and reheat coils operate as preheat and reheat coils. Sprays are in operation at all times to provide the required humidity.

In the interval between these two seasons, only the reheat coils are in operation to provide the correct discharge temperature for ventilating air. Hot water is the medium for the run-around coils when used for heating. This hot water is supplied from a steam to water heat exchanger.

Since much colder water is required for dehumidification than is needed by the room units, and since water for both is furnished by a single refrigeration system, some of the water returning from the room units is mixed with the chilled water entering the room unit circulating pump.

It is interesting to note that the shift from one cycle or operating condition to another is made automatically without effort unless manual control was specifically ordered.

Duct work with this system can be the conventional low pressure type or it can consist of high pressure conduit, depending upon the decision of the design engineer. This makes possible a choice of duct systems and a saving in duct costs. The duct carrying the

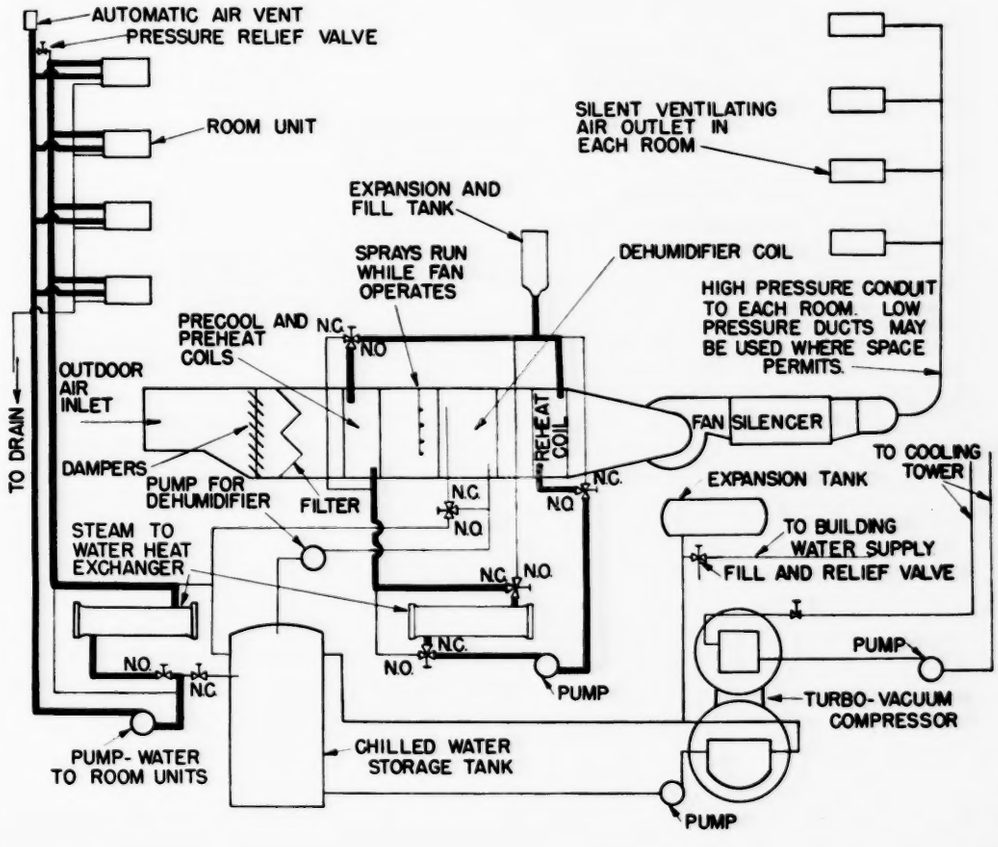


Fig. 2. Winter cycle of the Custom-Air system shown in heavy lines. Diagram also shows the various units and equipment that are part of the system.

ventilation air need supply the air at no greater pressure than that necessary to overcome the resistance of the duct work. No additional pressure is necessary to supply power for recirculating room air.

Low pressure ducts do not require the use of a special silent outlet and the customary grilles or diffusers can be used.

The high pressure duct is constructed of spirally wound sheet steel or it may be made of any light weight steel pipe or tubing. High pressure conduit is usually installed with welded joints although flanged and bolted connections are used where it may be necessary at times to remove a section of the pipe to reach other equipment installed back of the pipe. The conduit system must be designed with a small amount of flexibility to care for the expansion and contraction of the pipe due to temperature changes. Flexible tubing is usually recommended between the riser and the runouts.

Where the riser is usually long, then it may be sized on the basis of 4,000 fpm maximum air velocity and a maximum static pressure of $\frac{3}{8}$ in. per 10 ft of riser length. On this basis, static pressure will be the limiting factor on 3, 4, and 5 in. ducts while velocity will be the limiting factor on larger sizes.

Since this is not the only combined central and unit system available, it is of interest to point out some outstanding difference between the Trane design and what is generally termed the induced type system. In the latter, primary air is fed directly to the room and unit, flows past heating or cooling coils, and is then discharged through a grille into the room. Room units for such systems do not have a motor, fan or filters but consist primarily of finned coils and tubes for heating and cooling, and the controls.

Primary air supplies about one-fifth of the required air, and the balance is recirculated room air. The aspirating effect of the high velocity primary air discharged into the room unit induces a flow of room air over the cooling coils. Flexible tubing runs back of the baseboard to connect the steel tube high pressure riser that is supplying the primary air with the room unit.

Both systems have eliminated the necessity for the large size duct work that was required with older types of systems. The dehumidifying and ventilation features are supplied by a small volume of air distributed at high velocity. Sensible cooling is done in the room by chilled water piped from a remote water cooler. In this and the Trane system the primary air ventilates and controls the relative humidity, but in the induced system it is also used to provide the motivating force for circulating room air over the cooling or heating coils.

Makers of the Trane system claim that flexibility is its greatest advantage. It has been designed so that:

1. Conditions in any given space may vary widely without disturbing the system in any way.
2. Room units can be added to, or removed, without disturbing the balance of the system.
3. The supply of primary air from the central system does not limit the capacity of the room unit.
4. The building can be altered, partitions added or removed without disturbing the air conditioning system.
5. Occupants can come and go without disturbing the balance of the system.
6. The air conditioning may be shut off in vacant spaces in the building.

Caught by the Draft

Incidents when examined again after a lapse of a few years, may be quite amusing, no matter how annoying they may have been at the time. One such incident took place, several years ago, in connection with the building of an addition to a mercantile establishment.

Portions of the work were nearing completion. It was late in the season and the weather had become quite snappy. Hence, it was decided that temporary heat was required and, as the steam system was not in condition for use, salamanders were used.

One morning, the man in charge of the salamanders, having been directed to fire up, assembled his apparatus in a convenient location on a temporary platform about second floor level, where there seemed to be a good current of air which would carry away the fumes during the ignition stages. He carefully laid his kindling wood in the proper pattern and applied the torch.

The kindling wood which was selected this particular morning consisted of some left-over creosoted plugs, such as were being used to core holes in the concrete floor slabs. When the flames from these were cooled by the addition of coke to the apparatus, the combination gave off a dense and pungent vapor which reminded one of the cholera cure so amusingly described by Kipling.

Hardly had the coking operation been completed when "things began to pop."

The platform on which the salamanders were assembled was, unfortunately, built against a wall in which there was a fan intake, just above the platform level. Fumes from the salamanders promptly headed for this opening and the fan, just as promptly, disposed of them through the duct system. In fact, everything on the outside of the building was going like clockwork; but the inside, or at least those portions of it served by that particular fan, was like the north woods in autumn. It was impossible to see 10 feet ahead and the smoke was like tear gas.—*John J. Woolfenden, Engineering Staff, Smith, Hinchman & Grylls, Inc., Detroit, Mich.*

Joints for Plumbing and Laboratory Piping

J. E. YORK
Building Service Engineer, Stone & Webster Engineering Corp.

The first of a two-part article dealing with joints for sanitary piping and joints for the metallic and non-metallic piping serving laboratory equipment. This is part of a general series of articles by Mr. York on methods of joining pipe.

THE satisfactory installation of piping for sanitary fixtures and laboratory equipment requires a thorough knowledge of many special types of joints, and the necessary skill on the part of the mechanic

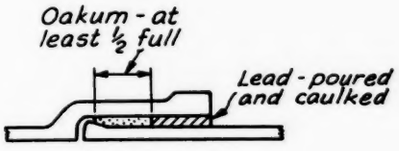


Fig. 1. Details of a sanitary waste joint.

installing the piping to make correctly the proper type of joint.

In addition to the joints described in previous articles of this series there are many special joint adaptations to meet requirements of plumbing regulations of the various communities and the approved practices of the trade.

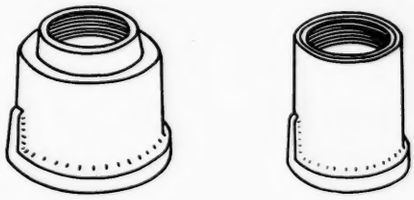


Fig. 2. Manhoff pattern cast iron vent hubs and vent spigots.

Besides having a knowledge of joints for connecting adjacent sections of cast iron, steel, genuine wrought iron, full weight brass pipe and thin wall tubes, it is necessary to understand the method of making joints between glass pipe, plastic tube, lead, Duriron, chemical tile pipe and piping of special synthetic chemical resistant materials. Special joints are also frequently required for connecting adjacent sections of piping of dissimilar materials and for joints between piping and equipment.

Joints for Sanitary Waste and Vent Systems

Joints for sanitary waste and vent systems are commonly made, Fig. 1, by inserting the spigot end of a pipe or fitting in the bell end of an adjacent section of pipe or fitting, packing with oakum, and pouring a lead joint. The lead should be thoroughly calked after it has cooled.

Screwed and screwed flanged joints* are made as described in previous articles. There are, however, many special adaptations of these basic types of joints which are peculiar to the plumbing industry. Some of these are shown and described.

Manhoff pattern cast iron vent hubs and vent spigots, Fig. 2, are used where it is necessary to connect screwed vent piping with cast iron soil pipe.

The hub end of the fitting shown in Fig. 2*a* can be used as such on cast iron soil pipe of the same size or may be used as a spigot for the next larger size pipe. The spigot end of the fitting, Fig. 2*b*, may be used for connection to the hub of cast iron soil pipe but cannot be used as a hub fitting.

The Tucker connection, Fig. 3, provides a means for making an approved type of joint between adjacent sections of screwed pipe and plain end pipe. The use of screwed unions between adjacent sections of piping on the sewer side of traps for plumbing fixtures is not permitted by most plumbing codes, but a satisfactory joint can be obtained by use of a Tucker connection.

To provide a suitable clean-out connection which may be readily and frequently removed by the plumber for inspection and cleaning of the inside of the piping system, iron body trap screw ferrules, Fig. 4, are inserted into a hub outlet on cast iron soil pipe and a poured lead joint made as described for Fig. 1. The plug should preferably be of brass with tapered threads to facilitate removal.

In Figs. 5*a*, *b* and *c*, respectively, Athol union ferrules are illustrated for connecting wrought iron and lead pipe with 2 in. cast iron soil pipe. Fig. 5*b* shows the ferrule with a brass tailpiece, to which the lead pipe may be soldered. No packing is required with this type of joint, as a ground joint is provided between the brass and cast iron.

The ferrule shown in Fig. 5*c* shows the method to

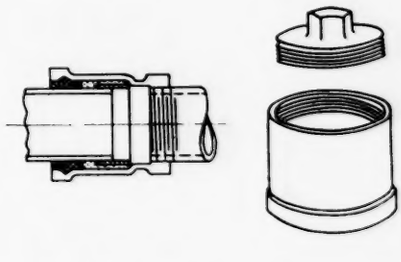


Fig. 3, left. Tucker connection. Fig. 4, right. Clean-out connection.

*Screwed Joints for Ferrous and Brass Pipe. HEATING AND VENTILATING, September, 1947. Flanged Pipe Joints. HEATING AND VENTILATING, October, 1947.

be used for connecting the lead pipe directly to the cast iron pipe without the use of solder. No packing is required as the turned-over end of the lead pipe forms the packing. The brass sleeve has a bead over

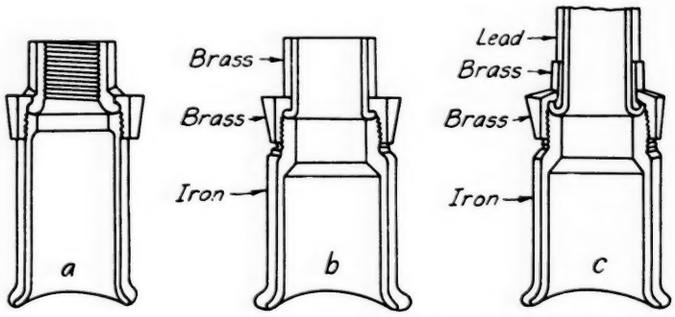


Fig. 5. Athol union ferrules for connecting wrought iron and lead pipe with cast iron soil pipe.

which the end of the lead pipe is turned. No special tools are required for making this joint and as it can be disconnected at any time, it may be used as a clean-out.

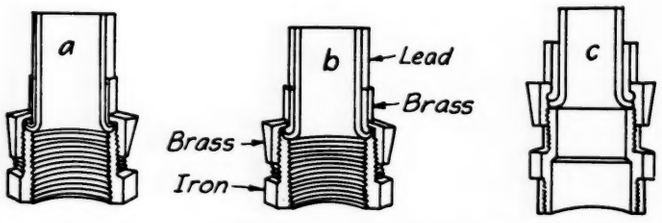
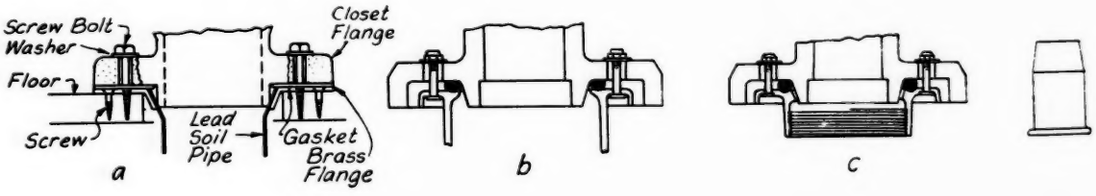


Fig. 6. Athol union couplings for connecting wrought iron and lead pipe.

Athol union couplings for connecting wrought iron and lead pipe are shown in Fig. 6. At *a* is a coupling for lead pipe to wrought iron pipe by soldering; *b* shows a similar connection without soldering; *c* illustrates a similar coupling of the same make for connecting lead pipe to any fitting having IP openings

Fig. 7, left. Forms of floor flange and gasket. Fig. 8, right. Taper pattern brass ferrule.



without solder. Construction is similar to that of the ferrule shown and described under Fig. 5*c*.

To make a water-tight connection between a water closet and the piping system, a floor flange and gasket are required. Connections between the floor flange and the piping system may be of lead, cast iron or threaded pipe.

With the brass floor flange for use with lead pipe, Fig. 7*a*, a flat rubber gasket is placed between the brass flange and the closet flange and the latter is fastened to the brass flange by bolts, thus making a water-tight connection. One end of the lead pipe is soldered to the brass ring and the other is wiped onto a plumber's brass ferrule, Fig. 8, which is inserted into the bell end of a soil pipe or fitting for a poured and calked lead joint.

Fig. 7*b* shows a cast iron floor flange with integral tailpiece to calk over 4-in. soil pipe; Fig. 7*c* llustrates a floor flange for use with threaded pipe with female thread. A fitting with male thread is available.

Joints for Lead Pipe

Use of lead pipe for sanitary plumbing systems is not as common as in earlier years but it is still used for service connections to street mains as in Fig. 9.

Fig. 9*a* shows a piece of lead pipe with wiped joints to a corporation stop on one end and to a soldering nipple at the other end. This type of connection provides sufficient flexibility between the main and the service pipe to the building to take care of unequal settlement. Where larger supplies are required for a building than can be readily taken from an existing main without cutting in a tee, a multiple branch water connection may be used as Fig. 9*b* and 9*c*.

Lead pipe is also used for traps and drains for laboratory and industrial chemical wastes, Fig. 10, where cast iron, brass or other materials would not withstand the action of chemicals in the waste. There are several types of joints which may be used with lead pipe. The most common is the wiped joint, Fig. 11. The general principle involved in the process of joint wiping is that of heating the parts to be joined by the metal employed to join them, and of wiping that metal (solder) into desirable shapes at the proper places by means of a cloth while the metal is in a plastic condition.

Wiped joints are used for joining lead to lead, or to brass or copper. When making joints, the metal should be heated to a temperature equal to that of the fusing point of solder. Care should be used to insure that the metals to be joined are not heated to their melting

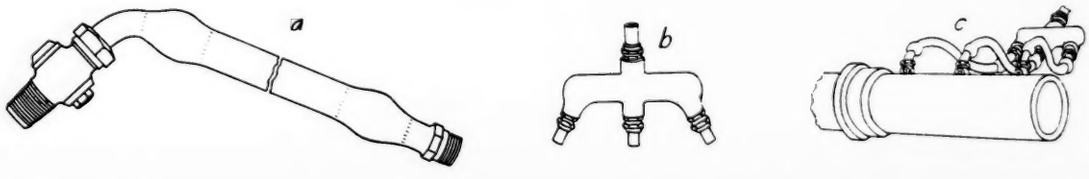


Fig. 9. Lead pipe service connections.

points. Proper heat may be obtained by gradually pouring melted solder over the parts to be joined. If solder that is too hot is used, a hole may be burned through the pipe when the solder is poured.

The solder usually employed for wiping is composed of two parts of lead to one part of tin and melts at a temperature of 441F. When used for wiping joints for lead pipe, it should be heated nearly to, but not much over, 626F which is the fusion point of lead.

When making a wiped joint the ends of the pipe should first be squared and after checking that the bore is true, the spigot end should be rasped evenly down to the bore at a slightly more obtuse angle to the outside surface than for the boring or opening of the recessed end.

It is important that there should be a space as shown at *e* in Fig. 11 between the ends of the pipe for solder, as when properly tinned this forms the strongest part of the joint, and unless made correctly the joint will probably last only a short while. It is always advisable to rasp against the end of the pipe so that the burr is made on the inside and so that none of the raspings get into the pipe.

When the ends are properly prepared they should be soiled back about three or four inches with plumbers' soil, a mixture of lamp black, glue and water. When dry the ends should be cleaned with a shave hook, cutting rather deeply at the beginning of the cleaning so that there will be a slight thickness of solder at the edges of the joint, otherwise it would be impossible to wipe the edges clean and perfect, because the feather edge will chill too quickly.

Before setting the joint, the top edge of the spigot end and the bottom of the receiving end should be soiled so that the two soiled parts will come together

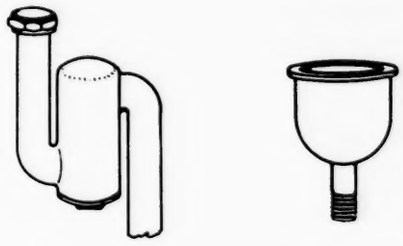


Fig. 10. Laboratory trap and drain.

when the pipe is in place. This keeps the solder from sweating through into the pipe.

The length of the cleanings does not increase with the diameter of the pipe. For a round joint on ⅝ in. pipe or 8 in. pipe the length should be the same, 2 to 2½ in.

The length of the joint, that is the distance between *c* and *d* in Fig. 11, should be as given in Table 1 for horizontal pipe. Joints shorter than listed in the table

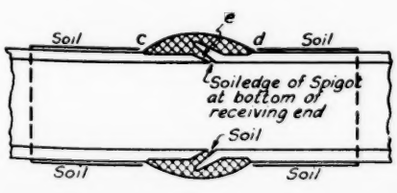


Fig. 11. Details of a wiped lead joint.

Table 1—Length of Joint for Horizontal Pipe

Type of Pipe	Diameter of Pipe, Inches								
	½	⅝	¾	1	1¼	1½	2	3	4
	Length of Joint, Inches								
Water pipe	2⅛	2¼	2½	2¾	3	3¼			
Waste pipe					2	2¼	2¼	2½	3

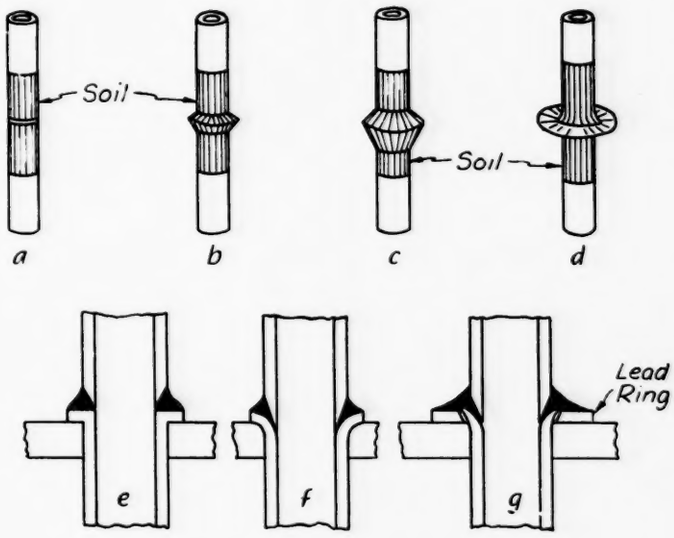


Fig. 12. Forms of joints for lead pipe.

will be too weak and if longer will be wasteful of solder.

Upright joints on waste pipe are usually not more than 2 in. long. When the pipes to be jointed are of different metals, it is best to increase the length of the joint somewhat or extend the tinning.

For instance, on copper pipe, especially for distilling use, some kind of galvanic or corrosive action takes place which destroys the union between the solder and the metal of the pipe. It is, therefore, usual on distilling work to tin across the end of the pipe and back on the interior in addition to the regular joint surface outside, making the tinning continuous, as its length and continuity seem to determine the period of time the joint will last.

Difference in the ratios of expansion, causing a shearing action, appears to have much to do with the life of joints when lead and brass, lead and copper or lead and iron are joined together by wiping. When lead is joined to lead the difference in coefficients of expansion for the mass of solder and the metal of the pipe with which it is in contact is so slight that little trouble is experienced.

The contour of the joint may be decided by allowing the thickness of the solder at the middle to equal 1½ times the thickness of the wall of the pipe. This holds good for supply pipe where the solder used is 40 to 45% good tin and 60 to 55% pure lead. On thin wall soil and waste pipe, or where coarser solder is used, twice the thickness of the wall is better.

Wiped joints should be used for lead pipe wherever practicable, but there are several other styles of joints equally serviceable for certain locations. Some of these are shown in Fig. 12.

The butt sweat joint shown in Fig. 12*a* is made by squaring the ends, tinning one end and sweating the other to it by heating with a torch. It is the weakest joint made but will at the outset stand any strain or internal pressure that the pipe itself will stand.

The blow joint, Fig. 12*b*, and the copper bit joint, Fig. 12*c*, are similar. However, for the blow joint, the solder is floated by aid of the torch and is not so heavy as for the copper bit joint. The latter joint is made with a soldering iron, the solder being melted and floated a little at a time until the joint is completed.

The wiped flanged joint, Fig. 12*d*, is made by flanging the lower section of pipe over a board. The upper section is beveled and prepared as for an ordinary wiped joint. The solder is applied with a ladle and wiped in the shape shown with a thick cloth.

Fig. 12*e* shows a square corner which should be avoided. The rounded corner, Fig. 12*f*, should be used except when a heavy weight is to be carried by the flange, in which case it should be reinforced by means of a lead ring or flange, as shown in Fig. 12*g*. The ring should be shaved on the top, and soiled on the outer edge and bottom, and must be laid on the board before the pipe is flanged over. Care should be exercised to see that the flanged part of the pipe is thoroughly tinned before proceeding to wipe.

The flanges shown in Fig. 12*e* and *f* are liable to be thinned too much or even split in flanging them over the board, and for this reason the joints are usually made too narrow. When a separate flange or ring, as shown in Fig. 12*g*, is used a wider and much neater joint is obtained.

Screwed connections, Fig. 13, are sometimes used between the tailpiece of sinks and traps.

Flanged connections may be made between two adjacent pieces of lead pipe, Fig. 14, and threaded pipe may be connected to lead pipe without soldering, Fig. 15, by means of a malleable iron connector. The flared end of the lead pipe is squeezed tightly between the beveled edges of the two flange pieces as the bolts are tightened, thus making a tight joint.

A connection is available for use between lead pipe and a threaded cast iron drainage fitting for use on laboratory benches.

The method shown in Fig. 16 is used for connecting a 2 in. cast iron waste from a laboratory table to a lead trap where the acid wastes do not permit the use of a brass ferrule for a calked joint. The cast iron bell and spigot fitting is completely lined with lead and the lead is carried back over the outside of the spigot end for sufficient distance to permit making a wiped joint to the lead connection for the trap.

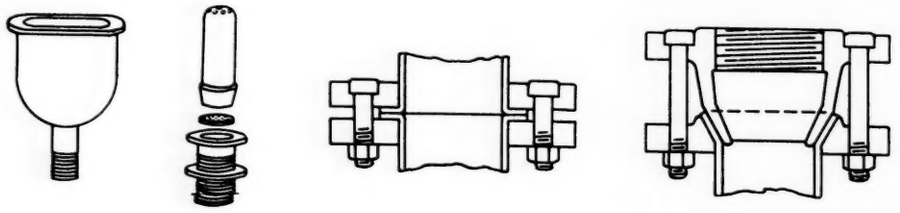


Fig. 13, left. Connection between tailpiece of sinks and traps. Fig. 14, center. Flanged connection for lead pipe. Fig. 15, right, Fitting for connecting threaded pipe to lead pipe.

Lead Burned Pipe Joints

Lead burning is sometimes used as a means for making pipe joints in lead pipe lines for chemical plants, and laboratories.

Lead pipe which is used for domestic work contains a small percentage of zinc and is unsatisfactory for chemical work. Chemical lead should withstand the action of strong sulfuric acid up to about 608F and should be 99.98% pure.

Filling rods should be cast from pure virgin lead.

When preparing pipe for lead burned joints, no flux or tarnish (soil) is necessary. The lead is first shaved in the required place and to the necessary length. The joint is fitted together and the flame and filling rod applied. The two surfaces of lead flow together and an autogenous weld is formed. Filling rods are fused into or onto the joint to give added strength.

Upright Socket Joint

There are several ways of making burned pipe joints. The simplest joint to make is the upright socket joint which is used on pipes of small diameter fixed vertically as shown in Fig. 16*b*. The bottom portion of the joint is opened wide. The upper portion, prepared with a feather edge as the male end of a joint would be prepared for wiping, is then inserted into the lower

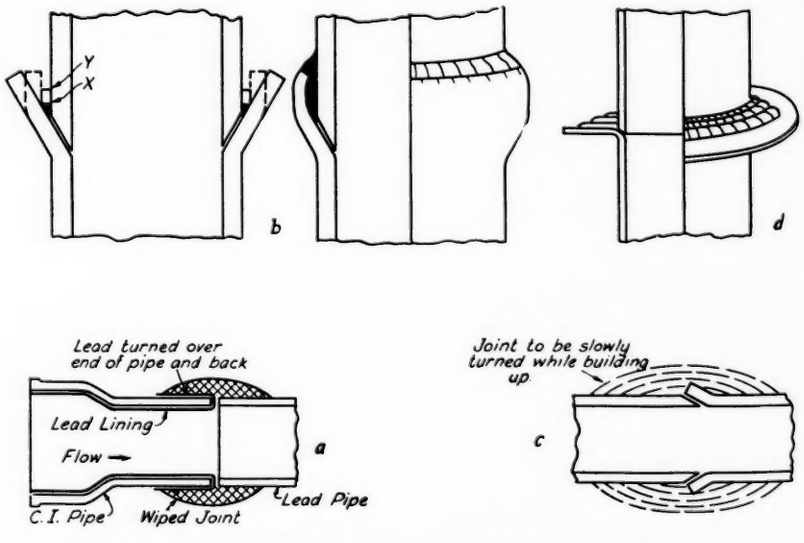


Fig. 16. Methods of making burned pipe joints for both vertical and horizontal runs.

portion, and the joint is then ready for the burning process. It is assumed the joint was previously shaved.

The first operation is to fuse the bottom part of the joint to the upper portion as low down as possible. When the operator is satisfied that it is fused right around, he can add a filling rod and load up until the joint is fused to the point *X*.

This gives the joint a good foundation to build up on. The next operation is to dress the expanded portion in, until the sides are parallel with the pipe. See position shown by dotted line, in Fig. 16*b*. The burning can now be recommended and lead added until the point *Y* is reached.

The remainder of the opened out portion can now be dressed in, until the lead forms the shape of a wiped joint. Again fuse more lead into the cavity and then finish off as shown at the right of Fig. 16*b*.

The lead-burner must be careful when finishing off the top of the joint so that he does not "cut in" on the upper pipe as this will considerably weaken the joint. This joint can be made up only on heavy section pipes that have to withstand considerable pressure and should not be used on light gage pipes.

Underhand Joints

When lead pipes are run horizontally and have to convey acid, heavy gage lead with underhand joints should be used. If the pipes to be joined can be turned, then a joint similar to an underhand wiped joint is made with the exception that no flux is necessary.

To burn a joint of this type, the first operation is to build up a foundation for loading the joint as shown in Fig. 16*c*. When this has been done, the joint can be loaded with a filling rod while the operator's assistant slowly turns the pipe around. Care must be used to insure that the joint is made evenly and symmetrically and not loaded on one side and flat on the other.

Flange or Block Joints

This type joint is made on light gage lead pipes (when fixed in a vertical position) for waste pipes in laboratories, etc., as shown in Fig. 16*d*.

The procedure is somewhat the same as for upright socket joints with the exception that the lower pipe is opened out considerably more and dressed to form a flange. The joint is built up in layers, each layer of lead being a little narrower than the preceding layer. Usually about three or four layers are sufficient to provide a satisfactory joint.

This type of joint is not satisfactory on heavy gage lead.

Split Joints

Where a joint is to be made in a horizontal line that cannot be turned, a split joint should be used.

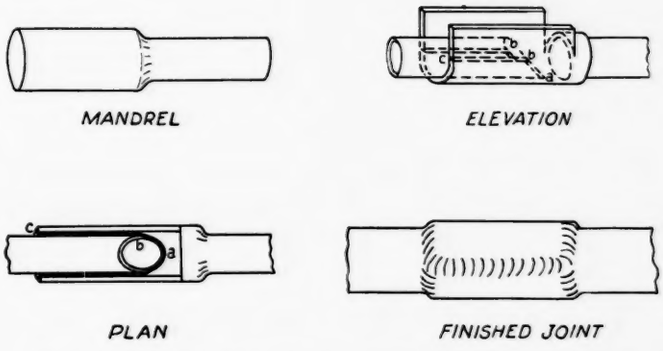


Fig. 17. Details of steps in construction of a split joint.

The end of one section of the pipe is expanded with a hardwood mandrel (boxwood preferably) to sufficient size to equal the diameter of the pipe plus twice the thickness of the lead itself. It is then cut and opened as shown in the elevation, Fig. 17. The end of the piece of pipe that is to be inserted is cut on a 45 degree bevel and then fitted into the opened end to the point *a* as shown in the plan and elevation.

The bottom half of the joint is burned inside, starting at the point *a* and gradually building up on both sides until points *b* are reached. After checking to make sure the burning is strong and free from pin or blow holes, the burning is then carried on horizontally from *b* to *c* between the inner and outer pipe on both sides. At these points the burning becomes external, and the two top sides are dressed down over the internal pipe and the burning of the joint picked up at *c* and loaded up until the top of the pipe is reached. When these four seams have been made, all that is left to be done are the flat butt seams on the top of the pipe.

If proper care is used in preparation and burning of this type of joint, good strong joints can be obtained.

Calculating Machine for Heat Transfer Problems

Installed in a new laboratory at East Pittsburgh, Pa., is a calculating machine constructed by Westinghouse Electric Corp., for solving difficult problems in the fields of heat transfer, applied mechanics and electrical circuits. It is termed the Anacom, and is the outgrowth of ten years experimentation with electrical circuit elements.

Parts of the computer are arranged along the walls of a room with the control desks located in the operating space in the center. Along one wall are located seven cabinets containing the electrical elements used to build up analogs of the physical machines. Between these cabinets are five plug-boards for making the proper connections. Other elements can be added from a calculating board in an adjacent laboratory, if required. Generally there are enough circuit elements in the calculator so that two problems can be solved at once. Accuracy within 1 to 5% is obtained.

Zoning for Heat Gains from Lighting in a Multi-Story Building

H. E. ZIEL

Mechanical Engineer, Albert Kahn Associated Architects and Engineers, Inc.

The lighting system in a multi-story office building may have a definite bearing on the type and method of control of the heating and ventilating systems. The liberal use of lights makes it necessary to zone the heating and ventilating systems in a manner to offset heat gains on various floors.

IN an office building heated with hot water radiators placed along the outside walls, the rooms are ventilated and the temperature of the air supply is controlled by zone heaters. Fig. 1 indicates a section through the building.

The heating system in this particular building is of the forced hot water type with zone control on the water supplied to the radiators. The heat loss on the two floors requires 4,700 sq ft of heating surface; 3,000 sq ft of heating surface is required on the second floor, and 1,700 sq ft of heating surface is required on the first floor to maintain a 72F temperature. The increase in heat loss on the second floor is due to the roof exposure, the side wall exposure on the two floors being practically the same. This is based on an outdoor temperature of 0F and no allowance made for the heat gain from lights or the ventilating system.

The lighting intensity to be maintained requires approximately 25,000 watts on the first floor and 31,000 watts on the second floor. This would be equivalent to producing a hot water heating effect of approximately 500 sq ft of radiation on the first floor and approximately 600 sq ft on the second floor.

However, the lighting produces a heat gain which is released in a manner to supplement the direct radiation on the second floor almost entirely.

The second floor lighting compensates in part for the heat loss through the roof. The first floor lighting releases the heat to the ceiling space below the second floor which heats the second floor slab. Thus with all lights turned on, the 1100 sq ft of equivalent hot water radiation is practically all added to the second floor with little heat gain to the first floor.

Zone control is therefore required on both the heating and ventilating systems not only to cover the variations in sun effect on the east and west sides of the building but to compensate for the heat gain from the lights.

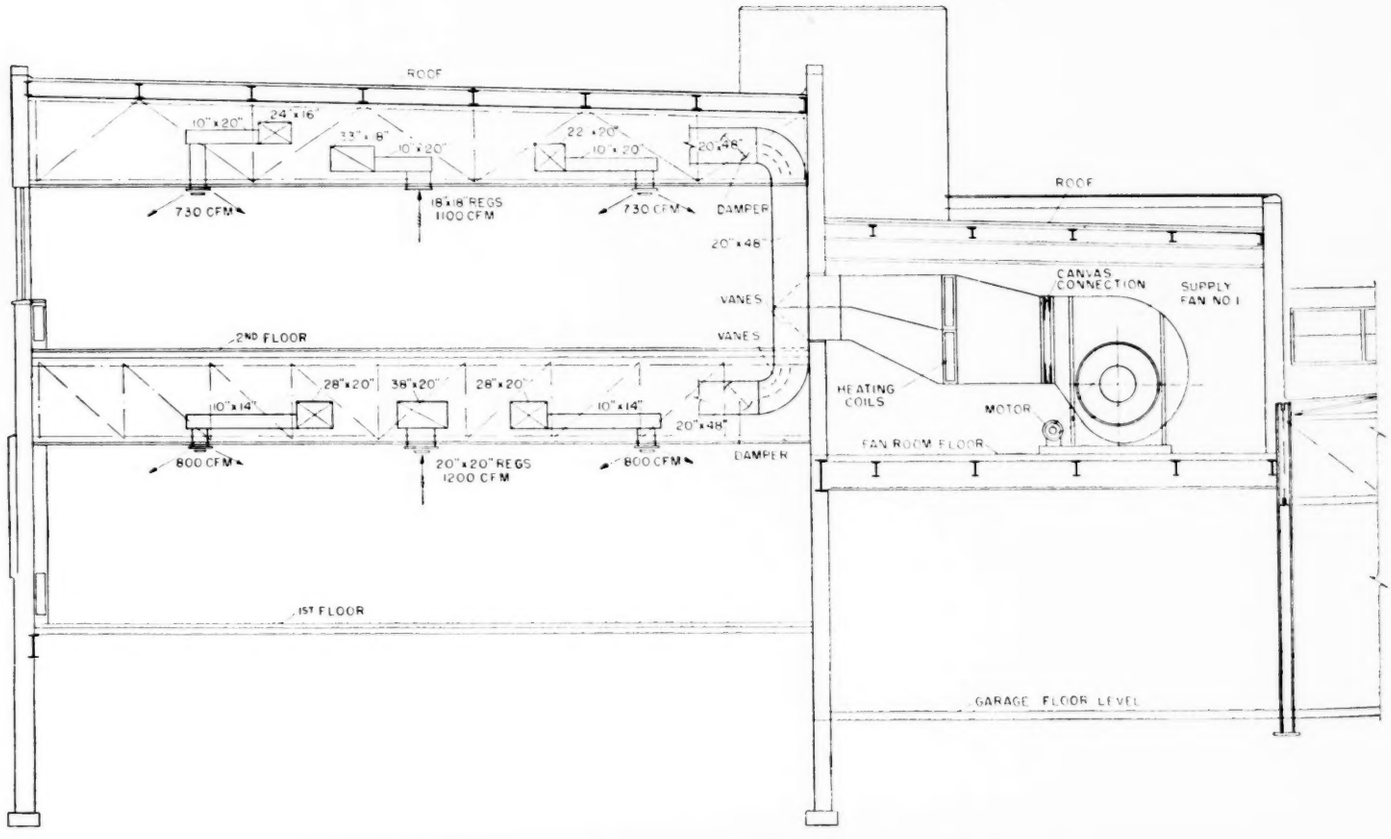


Fig. 1. Cross section through two-story building shows ventilation system.

A Snow Melting Job Pays Off

T. NAPIER ADLAM

The snow melting system pictured on this page is laid in Mr. Adlam's own front walk in West Orange, N. J. Details of installation are shown, and performance under the severe test of last December's 26-in. snowfall is described. Design of the system involved the special problem of laying pipe in the brick stoop and steps and was slightly complicated further by the long sweeping curve of the walk.

(Above) Coil supported on concrete base ready for brick and tile to be built up around pipe. Sinuous coil on the ground is to deal with the wider surface of the footpath near the steps. One pipe is placed under each step and a connecting bend formed so that each pipe is set back 6 in. from the front face of each step and about 4 in. below the surface.

(Above) The front of the Adlam residence in West Orange, N. J., faces due North. The snow melting system in the front walk and stoop includes a curved 40-ft sweep in the pathway. Two 1-in. pipes running 20 in. on centers the full length of the walk were placed on fine gravel and sand upon which the concrete foundation for a tile surface was poured. There was an expansion on this length of about .2 in. A fillet of plastic material inserted between the end of the pathway and the edge of the main concrete sidewalk (not shown) took up this movement without any damage to the tiled surface of the footpath. It is evident from results, however, that expansion of heated concrete is something which must be considered.

Actual installation of the snow melting system described on this page was precipitated by a serious sinking of the foundation under the front stoop. The bricks forming the original steps had become broken and distorted, making it imperative to rebuild the stoop upon a substantial concrete base.

Since the front of the house faces due North, very little sun reaches the stoop during the winter months, and before the system was installed the surfaces remained hazardous for long periods during frosty weather. Since a snow melting system already existed for the nearby driveway, it was necessary only to connect the pipe coils to the present boiler. The project presented a good opportunity to provide a permanent means of eliminating dangerously slippery surfaces and also to save labor required to clear away snow and ice from the front walk.

Performance of the system has been eminently satisfactory, even under the severe test of last December's record snowfall, as described in captions to the accompanying photographs.

(Below) The most severe test came on December 26, when 26 in. of snow fell in one day. The photo below, taken immediately after the storm, shows that a surface can be kept perfectly free of snow even in the most severe weather. The U. S. Weather Bureau has stipulated that a 1-in. fall of snow per hour constitutes a heavy snow storm, and the load this system had to carry can be appreciated when it is realized that during some parts of the day snow was falling at the rate of 3 in. per hr. So effective was the system that at no time during the storm did snow accumulate on any part of the stoop or sidewalk. A clean wall of snow 26 in. high can be seen on each side of the path, and no snow had been removed by any other means than the melting on the surface. During operation, the temperature of the anti-freeze medium was 185F with about 25F differential between supply and return temperatures.

Test Every Air Conditioning System

LESTER T. AVERY and JIM BLACK

A suggested test procedure to be followed by the engineer or contractor for checking the operation of air conditioning systems.

ANY job you can walk away from is a good job! When the installation is completed and all the motors and controls are turned on and everything works right, "ain't it a grand and glorious feelin'?"

How long will the job stay right? Two days? Two weeks? Two months? Do you lie awake nights, wondering if that heating coil really has enough capacity for zero weather, or if the controls will switch over to cooling satisfactorily if it gets hot tomorrow? Will the customer call you on the phone and complain of drafts, uneven temperatures, noise, and things he didn't notice at first?

The point is to emphasize the necessity of testing *every* air conditioning system. Test it thoroughly, honestly, on a definite prearranged program—the sooner the better. Balance the air, check for drafts, set and calibrate the controls, before they give trouble, and before the owner becomes critical of a system that is almost perfect. After all, it's the little things that count!

Testing serves an important purpose to the contractor engineer as well as to the owner. It is the proving ground of design. The test results must be reviewed with the designing engineer so he can see how his designs work. **Over the years it has taught us something about duct design, about systems that will more nearly balance themselves. We need less oversize for ignorance factor. We use less sheet metal than 10 or even 5 years ago.**

Who Should Make Tests

Granting you should test, then who should do it? Of all the brains and trades and skills it takes to install air conditioning, which one of the three groups shall be responsible for the testing?

(1) The consulting engineer? Yes, definitely so! He designed this thing and knows how it's supposed to work. Testing is an engineering procedure with slide rule and formulas. A mechanic can't run a test. But if the consulting engineer wants the test run by one of the contractors—which one?

(2) The heating and piping contractor? Perhaps so, if he has an engineer who can do it, but the testing stuff is really not right down his alley. He has other virtues.

(3) The air conditioning contractor? Yes—and this is a good reason for having one. This is the firm that will live with this plant. They will service the equipment years after the architect, engineer, general contractor, and piping contractor have forgotten it. If life is to be bearable they must test the system and get rid of the bugs before the first hot or cold day. They are better qualified to test and adjust, being familiar with all phases of the job—heating, cooling, air distributing, and control. And it requires the combined ability of a number of experts to work out the test on a large system.

The testing engineer is sort of a mechanic with an engineering background. He specializes in air flow and measurement. He knows duct design, refrigeration, electricity, and thermodynamics. He works with a box of tools, an assortment of weird looking instruments, a book full of data, and a slide rule.

Equipment Required

The instruments he carries are important, and it's surprising how few are available that are practical. They must be accurate, yet portable and rugged, as they take a beating going from job to job. Fig. 1 shows a typical instrument case. This case includes: a 4-in. rotating vane anemometer, Velometer with complete scales and jets, inclined draft gage, hand smoke gun, clamp type a.c. ammeter-voltmeter, sling psychrometer, 12 thermometers, slide rule, speed counter, and 3 smoke bombs.

The testing engineer has also available: Pitot tube, portable temperature and humidity recorder (24 hr), mercury U-tube manometer, and a pressure recorder (24 hr).

The data book includes: Instructions and data with a tabulation of the necessary factors for the measuring and calculating of air quantities at supply and return grilles; data from various manufacturers of

Fig. 1. Typical instrument case for testing air conditioning systems.

The authors are, respectively, President and Special Engineer, Avery Engineering Co., Cleveland, Ohio.

Job Name	AIR BALANCE READINGS—SUPPLY AIR SYSTEM										Contract No.
Grille No.	Design CFM	Size	Eff. Area	Des. Corr. Vel.	Actual Vel.	% Deviation	Actual Vel.	% Deviation	Actual Vel.	% Deviation	

Fig. 2. Log sheet of air balance readings and calculations.

specially shaped outlets, such as ceiling outlets, on the measurement and calculation of air quantities from these outlets; psychrometric chart; calibration data on instruments in the case; manufacturers' printed data on the operation and maintenance of various pieces of air conditioning equipment, including automatic controls, and various blank form data sheets for recording the log of the plant operation.

Test Procedure

When the testing engineer starts out to test a completed job, he should have a definite routine to follow. This keeps him on the beam and saves time. If you are going to test we suggest:

(1) Report to the customer. Tell him who you are, what you are going to do, and how long you expect to be there.

(2) Find a place to work at a desk where you can calculate and write the data and the report.

(3) Check the job for construction features, agreement with the drawings, appearance, tightness, proper blanking of coils and filters, and the general state of completion.

(4) Check all lubrication points, check direction of rotation of all motors. (We have found fans that ran backwards for years because no one ever checked them!)

(5) If the job has a chemical dehumidifier or other motorized equipment through which air passes, auxiliary to the main fan unit, put this equipment in 100% perfect mechanical operation.

(6) Open *all* air dampers full wide, and start the fan or fans. Measure the total air quantity being handled by the main fan unit. Check roughly the supply,

TEST SHEET

Job Name _____ Date _____

Address _____ By _____

Machine _____ Cont. No. _____

Completed _____

DATA

Time	Suct. Press.	Disch. Press.	Cond. Water Temp.		Out. Air Temp.		Ret. Air Temp.		Sup. Air Temp.		% O.A.	Room Temperature												
			In	Out	D	W	D	W	D	W		D	W	D	W	D	W	D	W	D	W	D	W	D	W

D = dry bulb temperature. W = wet bulb temperature.

Fig. 3. Sample performance log sheet.

return and outside air quantities to see if the relationship is approximately right. When it is correct, adjust the main fan speed to handle the design total air quantity. Temporary correction on too much air can be handled by dampers.

(7) Measure accurately and record the air quantities at each supply and return outlet. Check the quantity passing through special equipment mentioned in Item 5. Record the percentage of deviation from "design" of air quantities at each outlet. Balance the outlets by dampers or by blocking until all outlets are correct within 10%.

(8) Install permanent duct type thermometers in air ducts if and where these are specified. (A few thermometers will save a lot of time in future rechecks.)

(9) Lock hand dampers in place and mark their correct setting on the damper quadrant. Mark also the position of the quadrant when the damper is full open and full closed. (The latter applies also to motorized dampers.)

(10) Put cooling or heating equipment or both in operation using recommended procedure and check list for each item.

(11) Check the temperature control system for proper operation. Cycle all controls. Check electrical interlocks. Measure and record the voltage and amperage at all motors. Set controls at desired temperatures and pressures. Check all the calibrations.

(12) Check the entire system for noise and excessive vibration.

(13) Take a temperature log of the complete job including a check for stratification within equipment and ducts.

(14) Check the occupied space for drafts. Correct drafts if any are found.

(15) Install tags or labels for valves and the control panel board where and if specified.

(16) Report to the customer the condition of the system, and if anything is incomplete, what and when you are going to complete. Give him instructions as to operation and maintenance of the plant. Confirm later in writing. Have him review and sign the log sheets.

(17) Write up in report form the data taken for permanent record of the test.

What and how you record the data is pretty much optional. Fig. 2 shows a sample log sheet of air balance readings and calculations. A glance at the right hand column shows that the job was left in good balance. Fig. 3 shows sample performance log sheet.

A job that passes the test engineer is a good bet to please the customer. Test engineer should be more critical, more skeptical than the owner. In the final analysis he is the man who makes the system deliver what was promised. Test 'em and walk away!

Why Pipe Corroded Only on One Side of the Building

In the February issue of HEATING AND VENTILATING, page 107, the writer puzzled a bit over a problem of corrosion in a leader pipe at the twentieth floor of the office building in which he works. This piece of galvanized steel pipe installed 17 years ago was run inside the hung ceiling of a setback and was corroded on the inside in one zone or a straight line along its top. Pipe corroded in the same manner had also been removed in recent years from still other leaders, but only in their vertical sections and always on the same side of the building. There was no trouble elsewhere.

Came spring, the open window, then a sprinkling of soot over the office desk and soon the writer struggled with a thought which developed slowly in keeping with the laziness of the season. Was there not some connection with the soot and the corroded leader pipe? There was.

Now, no leader pipe had ever been removed above the twenty-fifth floor. There was a chimney on an adjacent building which terminated at the same level on the side of the building where leaders were affected by corrosion. There was soot on the setbacks; soot combines with moisture to produce sulfur-bearing water and that was that.

The writer picked up the phone, called one contractor—called two contractors. "Yes", they said, "we sometimes find leader pipes corroded on only one side of a building and always with corrosion in a straight line. Water keeps to one side of a vertical leader pipe for unknown reasons, though no doubt due to the fact that leaders are not erected in accordance with a plumbed line and, as a consequence, the water gets a start on one side."

To these thoughts the writer would add the comment that the corrosion was brought to a head somewhat due to the use of soft coal during the war. Soft coal contains more sulfur and gives off more residue. Corrosion was more noticeable below the eighteenth floor, no doubt due to a greater collection of soot from accumulation on more setbacks.

Some waters (so-called hard waters) deposit a film on the inside pipe surface and thus prevent or partially suppress corrosion action. Soft rain water or neutral waters do not deposit a film. Such waters become contaminated with soot and take up oxygen as they fall through the air and wash the setbacks of our skyscrapers. Oygen is further entrained as the water flows down a vertical leader. However, the corrosive action of oxygen is much slower than that of soot.

Unfortunately, in an open system there can be no water treatment, while deterioration or oxygen removal is of course impractical. Extra strong pipe will delay the replacement, particularly so with only oxygen-bearing waters. Pipe with an asphaltum coating or cement lined pipe should prevent the corrosive waters from reaching the metal. Such pipe, or cast iron pipe, should be used, particularly in the industrial areas where soft coal is widely used. All horizontal pipes should be pitched for drainage.—*T. W. Reynolds*

DIMENSIONAL AND CAPACITY DATA FOR STANDARD WEIGHT COPPER AND BRASS PIPE

(NOT TO BE CONFUSED WITH COPPER TUBE)

Diameter, Inches			Wall Thickness, Inches	Area, Square Inches			Weight per Foot, Pounds				
Nominal	Inside Actual	Outside Actual		Of Circle with Outside Diameter	Of Circle with Inside Diameter	Cross-Section of Metal	Of Copper Pipe	Of Brass Pipe	Of Water in Pipe	Of Copper Pipe and Water	Of Brass Pipe and Water
⅛	0.281	0.405	0.062	0.129	0.062	0.067	0.259	0.253	0.0269	0.286	0.280
¼	0.376	0.540	0.082	0.229	0.111	0.118	0.457	0.447	0.0481	0.505	0.495
⅜	0.495	0.675	0.090	0.358	0.192	0.166	0.641	0.627	0.0831	0.724	0.710
½	0.626	0.840	0.107	0.554	0.308	0.246	0.955	0.934	0.1338	1.09	1.07
¾	0.822	1.050	0.114	0.866	0.531	0.335	1.30	1.27	0.2306	1.53	1.50
1	1.063	1.315	0.126	1.358	0.888	0.470	1.82	1.78	0.3856	2.21	2.17
1¼	1.368	1.660	0.146	2.165	1.469	0.696	2.69	2.63	0.6375	3.33	3.27
1½	1.600	1.900	0.150	2.835	2.011	0.824	3.20	3.13	0.8731	4.07	4.00
2	2.063	2.375	0.156	4.430	3.343	1.087	4.22	4.12	1.451	5.67	5.57
2½	2.501	2.875	0.187	6.492	4.913	1.579	6.12	5.99	2.133	8.25	8.12
3	3.062	3.500	0.219	9.621	7.364	2.257	8.75	8.56	3.196	11.95	11.76
3½	3.500	4.000	0.250	12.566	9.621	2.945	11.4	11.2	4.176	15.6	15.4
4	4.000	4.500	0.250	15.904	12.566	3.338	12.9	12.7	5.454	18.4	18.2
5	5.062	5.562	0.250	24.300	20.122	4.178	16.2	15.8	8.734	24.9	24.5
6	6.125	6.625	0.250	34.471	29.468	5.003	19.4	19.0	12.79	32.2	31.8
8	8.001	8.625	0.312	58.426	50.281	8.145	31.6	30.9	21.82	53.4	52.7
10	10.020	10.750	0.365	90.761	78.854	11.907	46.2	45.2	34.23	80.4	79.4
12	12.000	12.750	0.375	127.675	113.098	14.577	56.5	55.3	49.09	105.6	104.4

Nominal Diameter, Inches	Circumference, Inches		Length of Pipe per Sq. Ft. of Surface, Ft.		Sq. Ft. of Surface per Foot of Pipe		Capacity of Pipe per Foot of Length		Length of Pipe in Feet to Contain		
	Outside	Inside	Outside	Inside	Outside	Inside	Cubic Feet	Gallons	One Cubic Foot	One Gallon	One Pound of Water
⅛	1.272	0.883	9.43	13.51	0.106	0.074	.00043	.00322	2325.6	310.6	37.17
¼	1.696	1.181	7.09	10.20	0.141	0.098	.00077	.00576	1298.7	173.6	20.79
⅜	2.121	1.555	5.65	7.69	0.177	0.130	.00133	.00995	751.9	100.5	12.03
½	2.639	1.967	4.55	6.10	0.220	0.164	.00214	.01601	467.3	62.5	7.47
¾	3.299	2.582	3.64	4.65	0.275	0.215	.00369	.02760	271.0	36.2	4.34
1	4.131	3.340	2.91	3.60	0.344	0.278	.00617	.04615	162.1	21.7	2.59
1¼	5.215	4.298	2.30	2.79	0.435	0.358	.01020	.07630	98.0	13.1	1.57
1½	5.969	5.027	2.01	2.39	0.497	0.419	.01397	.10450	71.6	9.57	1.15
2	7.461	6.481	1.61	1.85	0.622	0.540	.02322	.17369	43.1	5.76	0.689
2½	9.032	7.857	1.33	1.53	0.753	0.655	.03412	.25522	29.3	3.92	0.469
3	10.996	9.620	1.09	1.25	0.916	0.802	.05114	.38253	19.6	2.61	0.313
3½	12.566	10.996	0.96	1.09	1.047	0.916	.06681	.49974	15.0	2.00	0.239
4	14.137	12.566	0.85	0.96	1.178	1.047	.08726	.65270	11.5	1.53	0.183
5	17.474	15.903	0.69	0.75	1.456	1.325	.13974	1.0453	7.2	0.96	0.114
6	20.813	19.242	0.58	0.62	1.734	1.603	.20464	1.5307	4.9	0.65	0.078
8	27.096	25.136	0.44	0.48	2.258	2.095	.34917	2.6118	2.9	0.38	0.046
10	33.772	31.479	0.36	0.38	2.814	2.623	.54760	4.0960	1.8	0.24	0.029
12	40.055	37.699	0.30	0.32	3.338	3.142	.78540	5.8748	1.3	0.17	0.020

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DIMENSIONAL AND CAPACITY DATA FOR EXTRA-STRONG COPPER AND BRASS PIPE

(NOT TO BE CONFUSED WITH COPPER TUBE)

Diameter, Inches			Wall Thickness, Inches	Area, Square Inches			Weight per Foot, Pounds				
Nominal	Actual Inside	Actual Outside		Of Circle with Outside Diameter	Of Circle with Inside Diameter	Cross-Section of Metal	Of Copper Pipe	Of Brass Pipe	Of Water in Pipe	Of Copper Pipe and Water	Of Brass Pipe and Water
⅛	0.205	0.405	0.100	0.129	0.033	0.096	0.371	0.363	0.0144	0.385	0.377
¼	0.294	0.540	0.123	0.229	0.067	0.162	0.625	0.611	0.0294	0.654	0.640
⅜	0.421	0.675	0.127	0.358	0.139	0.219	0.847	0.829	0.0606	0.908	0.890
½	0.542	0.840	0.149	0.554	0.231	0.323	1.25	1.23	0.1000	1.35	1.33
¾	0.736	1.050	0.157	0.866	0.425	0.441	1.71	1.67	0.1844	1.89	1.85
1	0.951	1.315	0.182	1.358	0.710	0.648	2.51	2.46	0.3081	2.82	2.77
1¼	1.272	1.660	0.194	2.165	1.271	0.894	3.46	3.39	0.5519	4.01	3.94
1½	1.494	1.900	0.203	2.835	1.753	1.082	4.19	4.10	0.7606	4.95	4.86
2	1.933	2.375	0.221	4.430	2.934	1.496	5.80	5.67	1.273	7.07	6.94
2½	2.315	2.875	0.280	6.492	4.209	2.283	8.85	8.66	1.827	10.7	10.5
3	2.892	3.500	0.304	9.621	6.569	3.052	11.8	11.6	2.851	14.7	14.5
3½	3.358	4.000	0.321	12.566	8.859	3.707	14.4	14.1	3.845	18.2	17.9
4	3.818	4.500	0.341	15.904	11.451	4.453	17.3	16.9	4.970	22.3	21.9
5	4.792	5.562	0.375	24.300	18.033	6.267	23.7	23.2	7.827	31.5	31.0
6	5.751	6.625	0.437	34.471	25.973	8.498	32.9	32.2	11.27	44.2	43.5
8	7.625	8.625	0.500	58.426	45.663	12.763	49.5	48.4	19.82	69.3	68.2
10	9.750	10.750	0.500	90.761	74.660	16.101	62.4	61.1	32.40	94.8	93.5

Nominal Diameter, Inches	Circumference, Inches		Length of Pipe per Sq. Ft. of Surface, Ft.		Sq. Ft. of Surface per Foot of Pipe		Capacity of Pipe per Foot of Length		Length of Pipe in Feet to Contain		
	Outside	Inside	Outside	Inside	Outside	Inside	Cubic Feet	Gallons	One Cubic Foot	One Gallon	One Pound of Water
⅛	1.272	0.644	9.43	18.51	0.106	0.054	.00023	.00172	4347.8	581.4	69.44
¼	1.696	0.924	7.09	12.99	0.141	0.077	.00047	.00352	2127.7	284.1	34.01
⅜	2.121	1.323	5.65	9.09	0.177	0.110	.00097	.00726	1030.9	137.7	16.50
½	2.639	1.703	4.55	7.04	0.220	0.142	.00160	.01197	625.0	83.5	10.00
¾	3.299	2.312	3.64	5.18	0.275	0.193	.00295	.02207	339.0	45.3	5.42
1	4.131	2.988	2.91	4.02	0.344	0.249	.00493	.03688	202.8	27.1	3.25
1¼	5.215	3.996	2.30	3.00	0.435	0.333	.00883	.06605	113.3	15.1	1.81
1½	5.969	4.694	2.01	2.56	0.497	0.391	.01217	.09103	82.2	11.0	1.31
2	7.461	6.073	1.61	1.98	0.622	0.506	.02037	.15237	49.1	6.56	0.785
2½	9.032	7.273	1.33	1.65	0.753	0.606	.02923	.21864	34.2	4.57	0.547
3	10.996	9.086	1.09	1.32	0.916	0.757	.04562	.34124	21.9	2.93	0.351
3½	12.566	10.549	0.96	1.14	1.047	0.879	.06152	.46017	16.3	2.17	0.260
4	14.137	11.995	0.85	1.00	1.178	1.000	.07952	.59481	12.6	1.68	0.201
5	17.474	15.055	0.69	0.80	1.456	1.255	.12523	.93672	8.0	1.07	0.128
6	20.813	18.067	0.58	0.66	1.734	1.506	.18037	1.3492	5.5	0.74	0.089
8	27.096	23.955	0.44	0.50	2.258	1.996	.31710	2.3719	3.2	0.42	0.050
10	33.772	30.631	0.36	0.39	2.814	2.553	.51847	3.8782	1.9	0.26	0.031

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THE SALES ENGINEER

Planning the Sales Interview

BERNARD LESTER
Sales Engineering Consultant

EVERY piece of apparatus and every heating and ventilating installation is planned. Designs, drawings, materials, operations—all are set in advance. Can we say the same about the job of "engineering" the sale of apparatus and installations?

On the average less than one quarter of the sales engineer's time is spent directly with prospects and customers. The rest of the time is consumed by other matters. Too much attention, therefore, cannot be given in an effort to make the moments spent in the presence of customers yield the greatest return. Too frequently sales engineers associate effective effort only with customer conversation. It is a great temptation to depend upon one's wits to meet the immediate selling problem at the time it appears. The only reliable way to make selling moments count for most, is through advance preparation.

It has been said that "we learn to skate in summer and swim in winter." This means, of course, that mental practice is as essential as physical practice. This principle is especially true in selling apparatus.

Here are some pointers that even experienced sales engineers sometimes forget:—

(1) Plan the call or interview with the customer in advance. This may be done by mentally reviewing what you are going to talk about, what information is sought, and what reaction or decision is desired. If possible, be prepared with complete facts so that you can clear up questions in connection with the apparatus and its application as they arise.

(2) Look at yourself and your apparatus through the customer's eyes. Take the viewpoint of the customer and not your viewpoint. It is easy to talk about one's self and the product one sells. But what the purchaser is interested in is the service you can give him and the results that the purchase and use of the apparatus and equipment will bring in production savings and improvements in his final product. Talk results—that is, results to the customer.

(3) Be quick to appreciate and understand the particular interest of the person interviewed. Talk his language and not your own. The top executive won't dip into details. He thinks of money appropriated balanced against benefits gained. The shop superintendent is interested in details—those features that will help him and his men to make a better production showing. The equipment engineer thinks in terms of apparatus performance, output, accuracy, finish, the life of the machine, its convenience, how attractive it is to his men, how easily it is maintained, and whether service is available. The purchasing agent usually has a keen eye on price, delivery dates, and printed forms used in filling out orders. Sales arguments must all be "tailored" to the man you are dealing with and to his interests.

(4) Time the interview. When and how to stop is as important as when and how to begin. Sometimes the mind runs away and leaves the mouth talking. Usually a short interview is better than a long one, unless a conference is involved, and one or, at most, two points can best be put across at a time. Others should be left for later calls. With this method, ideas are not so likely to get jumbled in the mind of the customer.

(5) Be informative. Have a storehouse of information on materials and shop practice. Know what is new in your customer's field.

(6) A little drama in the presentation or interview adds spice to it, provided you are on solid ground. Drama is often added by the proper use of samples, literature, and data, provided they are presented in an interesting way. Don't clutter up the customer's desk with them. Bring them out at the right moment, and put them away as soon as they have served their purpose.

(7) Study the element of strategy, which is the art of maneuvering. A clever sales engineer is a good listener. While listening to his prospect, he can discover how best to make the next move.

(8) No matter what happens, keep a steady keel and a pleasant disposition. At the same time, take the customer's remarks seriously. Arguments may be most fruitful in reaching favorable decisions, but suggestions are usually more valuable. Don't win the argument and thereby lose the business.

(9) Never run down competitors. Their selling arguments can be capitalized upon, but their competition should always be ignored.

(10) Get the prospect's name straight. Repeat it while addressing the prospect. This is pleasing, and lends individuality to your message.

(11) Finally, always endeavor to shape the interview yourself after the initial approach has been made. Capable sales engineers make circumstances. They twist them to a point of advantage. They avoid letting circumstances control them.

(12) Evaluate every interview to see how you could have handled it better. Often something develops from an interview which directly points to the advisability of seeing someone else in the organization.

Experience is my Classroom

By T. W. REYNOLDS

PUTTING IN LESS RADIATION WAS MORE SATISFACTORY

Back in the boom days a skyscraper office building went up along 42nd St. in New York. A type of radiation which came into use about this time fitted along windows well enough, if one section were removed in each bay. This section had about 10 sq ft of rated surface, but the engineer would not think of putting in less surface than his calculations found necessary He would do so, however, if the writer, on behalf of the manufacturer, would guarantee the satisfactory heating of the spaces. This was a large order because heating depends upon many things other than radiators.

Knowing the usual engineer's tendency to factors of safety, the guarantee was given, especially so as the writer had noticed another factor of safety. A quick calculation had discovered the missing 10 sq ft of surface in the long radiator runouts of each bay. Actually the 10 sq ft could be taken as 12.5 sq ft, considering that each square foot of pipe surface emits 300 Btu.

As the years have gone by, the radiators have heated this building satisfactorily. The engineer in question is an old friend of the writer's, so the writer has reminded him upon more than one occasion that there were no complaints from lack of heat in this building. To which the engineer always replies, "Come to think of it, we have never had a tough winter since those radiators were installed."

This matter of guaranteeing to heat a structure with less radiation than the engineer computed seemed like a good racket and a legitimate one. The type of radiation could be easily supported from a type of window which the window manufacturer claimed would substantially reduce the quantity of air infiltration. Combining the two (radiator and window) and pooling of interests, the writer and a representative of the window manufacturer guaranteed to reduce radiation quantities in any building so served at least 10% below the usual calculated requirements and yet heat the building.

Many apartment house owners throughout Westchester County, New York, accepted the proposition as good business. The satisfactory heating of a building was no longer their responsibility, but the special appeal to the owners was the absence of overheating, particularly in milder weather. Owners of apartment houses have always complained of tenants opening windows. To the writer's best knowledge, all of the buildings involved are devoid of any complaints as to lack of heat to this day.

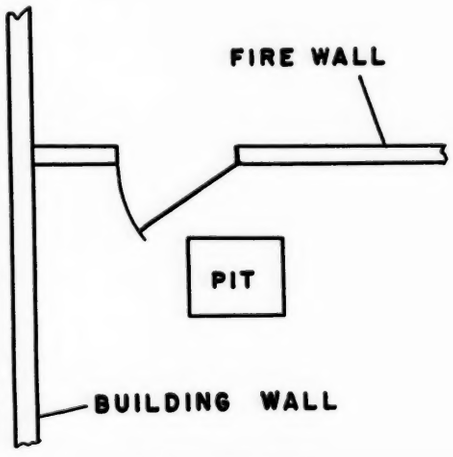
KEEP PITS CLEAR

In a railroad yard we visited the roundhouse and there removed the wood cover to a steam trap pit. Evidence of waste greeted us in the way of heat and steam.

The pit was in the floor of the main passage and near a door in the dividing fire wall. Visibility was not so good due to steam vapors and the usual smoke of such surroundings, while the din made hearing difficult.

Leaning over to catch the words of the one reporting his findings from the pit, the guard of the writer on the door momentarily relaxed. Through the door came a worker, backward turned as he closed the heavy door, then down the pit he went. A warning shout, the fellow below prepared himself, and neither was hurt.

Not knowing this, the writer climbed down quickly to join them, when a second worker came through the door and joined all of us. The pit was only about 7 ft deep, not enough to seriously injure anyone, but by the time the second man fell my associate had formed a habit of jerking his arm up to cover his head. So far as the arm went the blow could be taken, but unfortunately the arm held a flash light which caught the writer under the chin. Many lights flashed as the writer passed out. Brought to on the floor above, he noted the guard now at the door and wondered vaguely why engineers design on paper a location for a pit which they wouldn't like to visit in the manner described.



Keep Pits Clear

UTICA IS A COLD PLACE

It was many years back that the writer computed the necessary radiation for a railroad roundhouse at Utica, N. Y. At the time of design, the writer knowing that Utica is a very cold place, particularly when alighting from a sleeper on a frosty morning, doubled his factor of safety when computing the radiation quantities. Mr. Campbell, squad boss, said: "*Utica is a cold place*", and upped the figures. Mr. Van Buskirk, the mechanical engineer who had the final check and the most at stake, said: "*Utica is a cold place*", and returned the plans for a 10% increase in radiation.

Though many more years had passed until the writer had occasion to revisit this job upon another matter, he still had impressed upon memory the former incident of design. So the roundhouse foreman was casually asked if the place had enough radiation. The foreman said, "Enough, hell, it's been so hot we extended the valve stems to a distance where the wheels would be cool enough to operate. You couldn't get any more radiation in anyway." All of which brings to mind the making up of the yearly budget for the railroad. Knowing that the railroad directors would halve it, mechanical requirements were doubled, just as engineers will double their space requirements with certain architects, knowing that they will leave space for about half of those requirements.

FAREWELL TO A FINGER

Looking backward a long way the writer recalls one accident, speaking now with the wisdom of hindsight, where curiously enough, the victim would have been better off had he forgotten all about foresight. It was the victim's foresight that caused all the trouble.

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

At the time of this accident, the writer's daily bread and butter were obtained from wages earned as a piping draftsman investigating and recording what the railroad had to take care of in the way of existing pipes down in the bowe's of the earth, New York City, around 42nd St. and vicinity. Demolition of the old Grand Central Terminal was going on while related excavations were being made which gave the railroad, city and utilities information hitherto unknown as disclosed by a veritable labyrinth of pipes.

Coming now to the accident itself, a laborer's pick punctured a hole in one of these pipes. In the hole his finger went with due foresight. As he brought up his hand to smell the finger for gas he stared at a bloody stub where the finger had been, while shortly thereafter in the main post office down near the lower end of Manhattan Island an astonished clerk found an unattached and unaccounted for finger.

The pneumatic pipe had made its usual prompt delivery of a mail tube from railroad to post office. The laborer did not feel the finger go, it went so quickly. Neither did the writer see it go or arrive, but he can vouch for the accuracy of the tale.

A MATTER OF ZONING

When our government issues a directive it is made all embracive so as to cover the North, South, East and West, as well as all the cardinal points of the compass within those sections of our country. We in the air conditioning industry do the same thing when we use a central system, though we do attempt correctives for localities within the spaces by means of zoning. Some of our methods are better than others, none are entirely corrective.

The writer, for the moment, is not concerned with the best method of zoning, but rather with what he believes to be the worst, that is zoning by means of dampers. Perhaps it is better to know what to avoid than it is to know what to use, especially when you know from sad experience what you definitely do not want.

You take one long wing of an office building down which is run a central corridor and put a lot of offices along the east side of that corridor, then do the same thing along the west side. This was done in each wing of the Administration Building of the 1939 World's Fair, so with such a condition what could be better than to run a duct along each side of the building, join them together near the apparatus room, and there insert a zone damper, together with a static pressure regulator.

Being a fair, all design must be consistent with its temporary life. All materials must not last beyond the life of the fair, at which time they should automatically disintegrate into dust. One still remembers some of the other various orders, such as no copper to be used for gooseneck discharges about the roof, nor for louvers and screens at the outdoor air intakes. So this kind of equipment was then made of black iron. Consequently, some of it started to depart ahead of the time set and all of it cost more for frequent painting than it would have cost in copper without painting.

But to get back to the subject story, the zone dampers did their work. They throttled down the air on the sunny side and switched it over to too much air on the other side. The sunny side at such times then had too little of diffusion, ventilation and air movement, and the humidity built up. There were dead pockets and stratification, while the distribution from the room outlets was so upset, that air dropped down sooner than expected. A paradox of less air and more drafts was created. Nobody was satisfied on either side, not even the designer, until the dampers eventually rusted up and let well enough alone.

Except for interior zones and certain unusual applications the writer is not greatly concerned as to the best method of zoning when he can use triple glass or a type of screen which greatly reduces the sun effect and thereby eliminates most of the need for zoning.

QUADRANTS UNRELIABLE

One of the air conditioning systems at the 1939 World's Fair stubbornly refused to air condition a certain section, though there was a slight flow of air at the outlets. Dampering down on other sections did not help.

The writer decided to enter the duct leading to the troublesome section, did so, and found the damper closed except for leakage around it. Since then the writer does not depend upon indication of damper quadrants on the exterior of ducts, but insists on access doors at such points. Such doors are also useful for the cleaning out of ducts.

Incidentally, this is not the first and only time that the writer has found a damper closed.

SQUEEZING OUT THE MAXIMUM

The writer well remembers a boss he once had, one still living and still designing systems at a good old age. When in the design I would come to a tight place due to the architect being equally tight, the boss would take over and sweat around it trying to get a duct of respectable size through, over or under whatever we were trying to get through, over or under. Finally, with recognition of the inevitable, he would say, "Well, go ahead, size the duct as conditions allow, the air will just have to hurry by a bit faster," and quite often it did.

The trouble with most such problems is that we are not always as flexible as the duct. Sometimes velocities can be raised a bit, or the air quantity reduced by increasing its temperature rise. Sometimes it is found that the duct does not even have to go through at the point in question and sometimes by calm reflection we happen on the startling discovery that the duct itself is not really needed after all. This, then, is original thinking, simple as it all is, and saves the continually butting of one's head against hard walls that bounce you back fully as hard and as often.

IT PAYS TO CHECK

Over in Brooklyn a heating contractor did a whale of a business about 30 years back, too big for a manufacturer of heating equipment to ignore. The manufacturer was requested by the jobber on behalf of the contractor for the testimony of a witness expert in a law suit. So the writer was elected to defend the contractor against the owner of a 3-story apartment house. The owner contended that he had the worst heating system within the confines of Brooklyn.

The writer did not like this contractor's work in general, nor this job in particular, though it was not a bad job as speculative jobs go, the owner having shopped around. On the other hand, there arose a desire for a battle of wits when the owner retained a capable consulting engineer, a friend of the writer's.

On cross examination, the writer handled the usual opening question successfully, that is, whether he was not being paid for his testimony and services. He replied, "Only for his opinion." Next he was asked as to the reputation of the consulting engineer, and could only say that it was of the best. This was a funny one, our lawyer having previously qualified the writer as an expert, his duly established expert must now establish the consulting engineer as an expert. This certainly put both experts on an equal basis, and would seem to dispense with any further need for the services of either one.

So the writer wrote notes to his lawyer, questions for him to propound, just to show that an expert could turn lawyer, if no longer needed as an expert. Thus, our lawyer became successful in dismissing the blue prints of the engineer, prints that the jury never understood and the sort of thing that is generally inadmissible on legal grounds. Our lawyer then started to go to work on the owner's janitor, and asked him if he ever

ventilated the place by opening windows. The janitor replied he did and the lawyer asked, "How then do you expect to heat the place?" This was quickly followed with the question "And, you had them open on the day in question?" By this time the janitor was alerted and boomeranged: "Yes, I opened them to let the heat in, it was warmer outside."

Things were getting interesting now, the jury woke up, and the writer was again up for cross examination. He had previously testified that it was inherent in a one-pipe steam heating system to knock, noise being one of the owner's complaints. There seemed no need to amplify the statement, no one having asked if such a system could not be designed without water hammer.

Their lawyer did not know how to get around this statement technically, so he asked a practical question, "What kind of a heating system have we here in court?" One could see the blow coming fast; a glance around showed nothing but one-pipe in the radiator settings, so the writer of necessity designated the system as one-pipe. Upon which the lawyer hardly waiting for the answer to be completed, waved his arms dramatically and said, "And, you don't see (he meant hear) any knocking here." Thinking fast from the time of his first question (remembering that the weather was mild and noting the partly opened windows) the writer got out of an unpleasant situation by saying, "And, you don't see any steam turned on either."

On the way out of court the writer put his hand on a radiator in a matter of fact way and found the steam on. No one had thought to check the writer's positive manner. For the reader's benefit this story is true in every respect. The questions and answers were actually as given herein.

MUCH ABOUT LITTLE

It's a gift to be able to know very little about a subject, yet say much. However, if your listeners are as little or less informed, I suppose that there is no harm done. Everyone concerned will wind up thinking he knows more about the subject than before, but will know less due to misconceptions.

I am thinking of your boss, or any boss for that matter. He is the busy executive and has not too much time for engineering while keeping the wolf from the door. He calls you in and says:

"I've got to make a few remarks at a meeting on radiant heating. Tell me all about it in the next five or ten minutes."

One of those few minutes go by before you gather your wits together and give him some highlights which you know he will pass around at the meeting and somehow still retain the respect of the assemblage. As I say, it's a gift, and perhaps he does a better job than you would.

You go to a convention for stores because the day will be devoted to the subject of air conditioning for stores. There are some able engineering speakers present, but the men from the stores are executives who are going to grasp but little of what is said. You look over the roster of attendance from the stores and find none who is chief or any other kind of engineer; none who operates the air conditioning systems. It's going to be a wonderful meeting with a great lack of help to everyone.

OVER-SIZE BOILERS

In the exuberance of more youthful days, as helped along with a little spirit of Prohibition days, a group of friendly engineers helped the writer to roll in the round sections of a new boiler for his home, then in New Jersey. By proper jockeying around of a section they purposely managed always to have the basement door too small for the passage of the sections and there were many remarks about heating the street with steam as well as the house.

All of these engineers have lost their spirit of horse play by this time, but that boiler has lost none of its original pep of 16 years back. It always heated the house with no pressure showing on the gage, the piping system being also liberally sized. A further advantage was the burning of buckwheat coal, which coal requires a larger grate.

Notwithstanding this example of the advantages obtainable by over-sizing the boiler, there are often many disadvantages in such a practice. Lower gas velocities deposit much more soot on heating surface, and if the boiler over-size is one which gives larger flues, there is a larger central core of gas in each flue which does not wipe the heating surfaces. So there is no good economics in investing money for a period of 15 years or more in excess heating surface if that surface is not well arranged for proper gas travel over the surface and the flues are not filled with gas.

It takes longer to get up a fire in an over-size boiler, as the excess surface kills the draft, so that there is not enough air to support complete combustion. Such a boiler has too much resistance, the fire comes up only as the fuel bed burns down to a thin fire. Experimental boilers have been built in laboratories to prove the disadvantages of over-size.

A boiler need not be sized for economical use of fuel during infrequent load such as occurs with the pick up load, yet this is sometimes done for installations in churches.

As a rule you can go in most any church and remove or make inactive a goodly portion of the grates and thereby save fuel. Fuel can also be saved in such structures by never letting the edifice go below 50F in temperature. Putting the boiler capacity in two boilers rather than one will also save fuel in churches, one boiler for the normal load, and the other for the pick up requirements.

QUITE A RELIEF

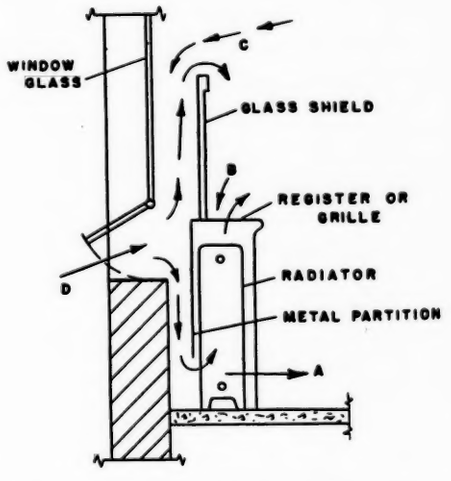
The writer recently came across an installation of pressure reducing valves where the respective relief valves and their exhaust pipes to outdoors were as large as 6 in. Investigation disclosed that these reliefs were sized on the basis of relieving all the steam that the reducing valves could pass. About 10% of that quantity would have been ample, just enough to pass any possible leakage from the reducing valves, so that excessive pressure could not build up in the system.

WIND UPSETS CALCULATIONS

The accompanying sketch is a variation of a presentation, Page 101, HEATING AND VENTILATING, June 1947, for the elimination of downdrafts from high windows. The variation is a section of the window which can be opened and this is the rub. It has been done, I have seen it, but don't do it.

The wind at sufficient pressure will either by-pass above the radiator up past the glass shield, go through the radiator too fast for proper heating, or, where there is a bottom inlet register at *A*, will by-pass below the radiator, causing cold drafts along the floor. Sometimes all of these difficulties may be present at the same time. Furthermore, under some conditions, the air at *A* or *B* may even reverse and come out at *C* or be wasted to outdoors through opened windows to *D* whenever the wind reverses.

Even with the window closed there may be trouble where the wind blows on glass not tightly fitted. Results to a certain extent depend upon the air flow through the radiator as affected by height and air resistance of the radiator.

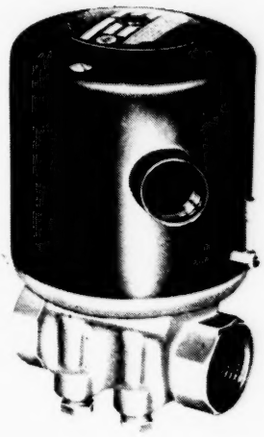


An arrangement where the air is apt to go anywhere.

NEWS OF EQUIPMENT AND MATERIALS

Gas Valve

NAME—General Control K-3H magnetic gas valve.
PURPOSE—For the control of gas flow.
FEATURES—Operator part of valve is sealed from the fuel gas without



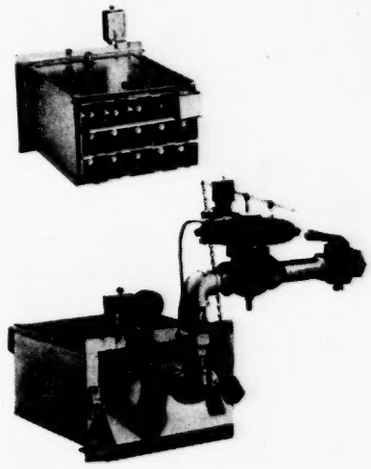
interfering with valve operation. Valve opens and closes gas fuel supply in response to room thermostat. A lever type manual opening device permits setting valve in open position in event of current failure. This same lever may be used to manually close the valve at other times. Upon resumption of electric current, a trip automatically returns the valve to the normal thermostat control. Valve has a straight through flow for maximum gas capacity and closes automatically upon current failure.
MADE BY—*General Controls Co., 801 Allen Avenue, Glendale 1, Calif.* **161**

Enamel Paint

NAME — Sherwin - Williams heat-hardening low-gloss enamel.
PURPOSE—Enamel paint for outside exposure on aluminum.
FEATURES—Enamel is spray-applied and fast-baked to provide a hardness equal to that of refrigerator finishes. Tests have shown finish to be very resistant to 2,000-hr accelerated weatherometer exposure and 1,500-hr salt spray exposure.
APPLICATION—After proper surface has been prepared, the aluminum may be roller coated with primer and baked. Metal is then fabricated and later sprayed with the finish bake coat. Both the primer and finish coat may also be applied after the metal has been fabricated.
MADE BY—*Sherwin-Williams Co., Industrial Div., Cleveland.* **162**

Gas Burner

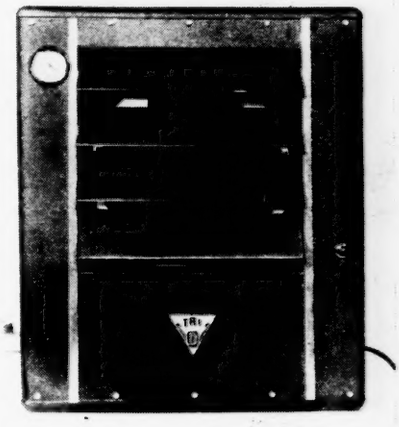
NAME—Lientz series SP gas burner.
PURPOSE—Gas burner for steam and hot water boilers, and warm air furnaces for large apartment houses.
FEATURES—Mixing plate and multiple-orifice burner tips are made of stainless steel. Burner comes as a complete packaged unit ready to install. It includes a thermocouple safety pilot with pilot cock, gas



valve, low-voltage transformer, low pressure regulator, operating control, manual main gas control valve, and complete piping through a manual valve. Burners may be used with manufactured gas or liquid petroleum gas-air mixtures of about the same Btu content as natural gas. Illustration shows the front and back views of unit.
SIZES AND CAPACITIES — Provide from 150,000 to 2,000,000 Btu per hr.
MADE BY—*B. P. Lientz & Co., P.O. Box 2275, Kansas City, Mo.*.....**163**

Unit Heater

NAME—Tri-Dee heater.
PURPOSE—Space heating through electric-steam heating plant.



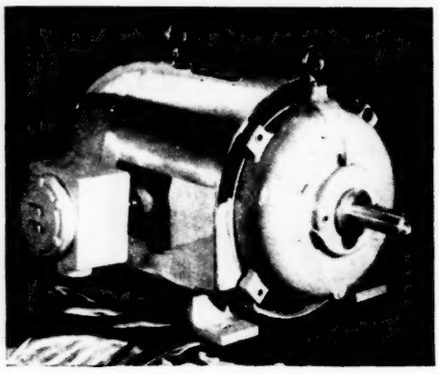
FEATURES—Electric current is used to generate steam. A 4-blade pressure-type fan forces air over the steam heated copper fin tubes. Unit is automatic, is said to maintain constant room temperature and to provide heat in less than three minutes. Adjustable louvers direct heated air where desired. Heater is provided with a 1/25-hp fan motor. Power consumption is 7.5 kw and output, 25615 Btu per hr.
MADE BY—*Tri-Dee Manufacturing Co., 910 Chalmers, Detroit 15, Mich.* **164**

Grille

NAME—Louvaire grille.
PURPOSE—To provide ventilation through doors or partitions.
FEATURES—The horizontal, herringbone shaped bars of grille permit ample ventilation. Grilles are made in standard and extra large sizes and can be obtained in special finishes.
MADE BY—*Stewart Manufacturing Co., 610 Bloomfield Ave., Bloomfield, N. J.* **165**

Motor

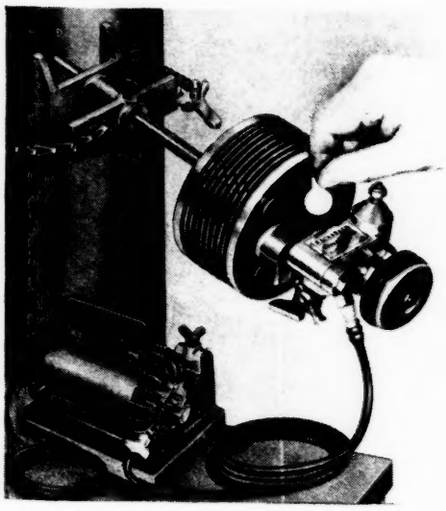
NAME—Reliance chemical motor.
PURPOSE — Corrosion-resisting a-c motor for general application in the chemical industry.



FEATURES—Motor is provided in frame sizes 203 to 326. Monel metal has replaced steel in the outer cover of this motor, in the fan cover, and in the construction of the lead outlet. Cast bronze replaces cast aluminum in the fan, and extra grease and bearing protection is provided by the addition of bronze shaft collars. Bearings are of the double-shielded ball-bearing type. Motor is built to standards of the Underwriters Laboratories for operation in locations where gasoline, oil, naphtha, alcohol, solvent vapors, and natural gas are present. Motor is explosion-proof.
SIZES AND CAPACITIES—From ½ to 20 hp and speeds from 600 to 3600 rpm.
LITERATURE AVAILABLE — Bulletin C-130.
MADE BY—*Reliance Electric and Engineering Co., 1076 Ivanhoe Rd., Cleveland 10, Ohio.* **166**

Smoke Tester

NAME—Smoke tester for oil burners.
PURPOSE—Portable smoke meter for conducting smoke tests on oil burners.
FEATURES — Unit consists of a sampling unit with a hose connection to an electrically operated vacuum pump placed near the sampling point. For testing smoke content, sampling tube is inserted into the flue pipe through a 7/16-in. hole located between the outlet and barometric draft regulator. A test disc is locked in the sampling unit, the vacuum pump connected to a source of electrical power, and the time control switch thrown. By this means an accurately controlled sample of the flue gas is sent through the test disc which changes in color to a shade of gray from light to dark, depending upon the smokiness of the flame. Test disc is then removed and soot content of the sample obtained by comparing color of exposed disc to a standard scale. Complete unit is packed in a metal carrying case.
LITERATURE AVAILABLE — Leaflet 746.



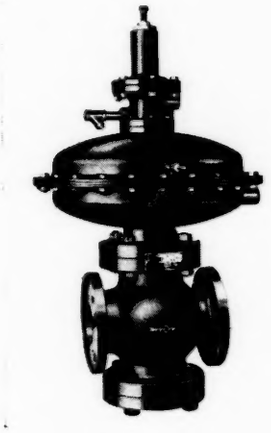
MADE BY—*Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh 8, Pa.*.....**167**

Prefabricated Duct

NAME—Lamneck simplenic system of prefabricated duct.
PURPOSE—Simplified ducts and fittings for forced air heating systems.
FEATURES—Duct, extending from the plenum is the same size its full length and requires no increasers or reducers. The large end openings of the take-off fittings have twice the area of the outlets to assure maximum capacity of system. Standard duct is 8 in. deep. Makers claim a considerable saving with this system because of a decrease in the number of connections required.
MADE BY—*Clayton & Lambert Mfg. Co., Louisville 10, Ky.*.....**168**

Gas Regulator

NAME—Hammel-Dahl 5000 series pressure loaded gas regulator.
PURPOSE—For supersensitive control of gas pressure in pipe lines.
FEATURES—Unit may be used on either reducing or back pressure service or any other pressure up to 100 lb per sq in. Valve body may be cast iron or steel. The lower steel diaphragm case is welded to a forged steel flange which is piloted into and bolted to the valve body. Fluid pressure from the outlet side of valve is applied to the under side of a large area diaphragm. Loading pressure from an integral pilot is applied to the upper side of the diaphragm. Construction eliminates both springs and packing gland. Valves may be used on air, gas, water and oil service. Large area Neoprene diaphragms with fabric insertion are used.



SIZES AND CAPACITIES—½ to 12 in.
MADE BY—*Hammel-Dahl Co., 243 Richmond Street, Providence 3, R. I.* **169**

Water Heater

NAME—Bryant model 115 water heater.

PURPOSE—Heating for domestic hot water.

FEATURES — Destructive electrochemical action is avoided by a magnesium alloy rod which extends into the water from the top of the tank. A porcelain enameled aeration pan radiates heat to the water and keeps the base and door cool. Automatic controls are placed at the side of the tank. Safety pilot provides shut-off if main line gas supply is interrupted. The gas burner is cast iron and a removable plug in the spud adapter permits cleaning the orifice without disassembly of the burner. Water tank is constructed of heavy gage steel, hot-dip galvanized. Heater is available for use with natural, manufactured, and liquefied petroleum gases.

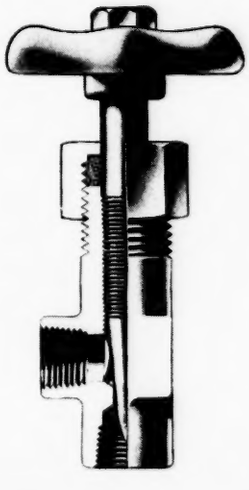
SIZES AND CAPACITIES—Made in 20, 30, 40 and 50-gal sizes.

MADE BY—*Bryant Heater Co., 2036 E. 22nd St., Cleveland.* **170**

Needle Valve

NAME—Bulldog micrometer valve.

PURPOSE—Needle valve to provide fine adjustment flow.



FEATURES—Valve is built with a stainless steel stem. A micrometer thread which is machined onto the steam permits the valve to be opened or closed for unusual accuracy of flow control. Bodies are machined from solid bars. Threads in the body are of class 3 fit and are inspected to aircraft standards.

SIZES AND CAPACITIES—⅛ and ¼ in.

MADE BY—*The Carpenter Manufacturing Corp., 9532 Detroit Ave., Cleveland 2, Ohio.* **171**

Coupling

NAME—1300 series Roylyn coupling.

PURPOSE—Automatic shut-off of flow upon disconnection and instantaneous flow on connection.

FEATURES—Coupling is available with valve in either or both halves

of coupling. When used together these valves are mutually activating to open when connected and close when disconnected. When an open coupling is used with the valved nipple, the latter is opened only by flow, thus providing a check valve action. It is available in Dural, bronze and steel.

SIZES AND CAPACITIES—½ to 2 in.

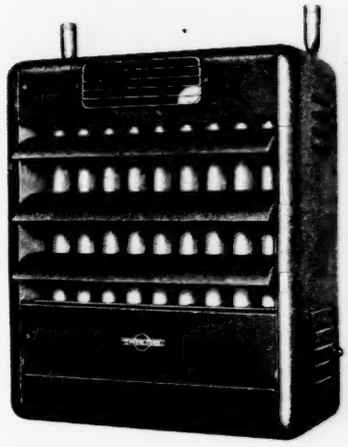
MADE BY—*Roylyn, Inc., 718 W. Wilson Ave., Glendale 3, Calif.*...**172**

Unit Heater

NAME—Peerless unit heater.

PURPOSE—Space heating.

FEATURES—Fan consists of four overlapping blades. A limit control inside the cabinet shuts off gas to the burner should unit exceed safe temperature limit. Burners and pilots are mounted on a hinged pan which swings down for easy servicing. A totally enclosed G.-E. motor, rubber mounted, has been especially designed for fan duty. A



pressure regulator maintains uniform gas pressure to burners.

SIZES AND CAPACITIES—Five models, from 65,000 to 200,000 Btu input rating.

MADE BY—*Peerless Manufacturing Corp., Louisville 10, Ky.*..... **173**

Condensate Pump

NAME—Condaflo.

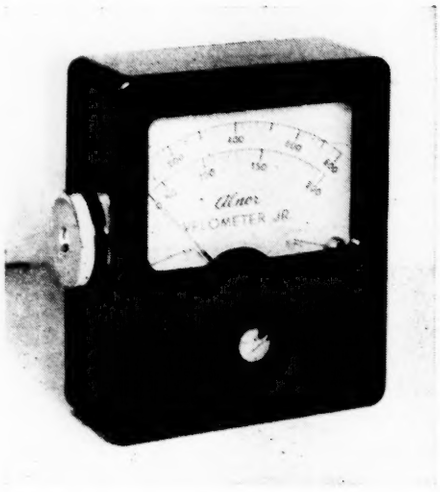
PURPOSE—Condensate return pump.

FEATURES—A packaged condensate return pump to provide a constant flow of steam and a rapid return of high-temperature condensate to the boiler. Unit occupies 18 by 24 in. floor space and has a capacity of 15 gpm at maximum discharge. Discharge pressure is 20 lb per sq in.

MADE BY—*Domestic Engine & Pump Co., Department 3, Shippensburg, Pa.* **174**

Air Meter

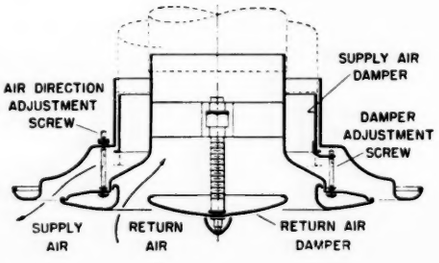
NAME—Alnor Velometer Jr.
PURPOSE—Portable, direct reading instrument for the measurement of the air velocities in unrestricted areas.
FEATURES—Unit is designed for heating, ventilating, air conditioning and refrigerating work not re-



quiring the use of jet attachments. Instrument is calibrated to provide direct reading of air velocity in either feet per minute or miles per hour. Movement of instrument is double-pivoted and double-jeweled.
SIZES AND CAPACITIES—Unit measures 4 in. high, 3 in. wide, 1½ in. deep and weighs 8 oz.
LITERATURE AVAILABLE — Bulletin 725.
MADE BY—*Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago 10, Ill.* **175**

Air Diffuser

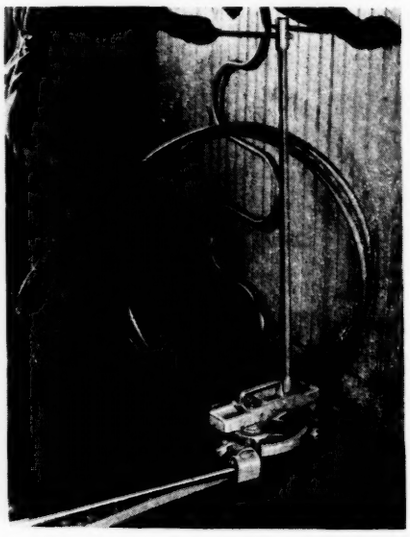
NAME—Kno-Draft air diffuser.
PURPOSE—For use where air is to be both discharged from and returned or exhausted through a common unit.
FEATURES — Supply air is discharged from between the outer and intermediate cones and return or exhaust air is drawn through the center section of the diffuser. Supply air is ejected away from the return air opening which is said to eliminate short-circuiting of supply air into the return air opening. Supply air volume is controlled by a cylindrical, sliding, sleeve-type damper fitted to the inside of the diffuser neck. Turning control screws raises or lowers the damper. Varying the air direction is done by raising or lowering the inner assembly. The center cone constitutes the return air damper. It is rotated on a central operating screw—clockwise to close, counterclockwise to open.



MADE BY—*W. B. Conner Engineering Corp., 114 E. 32nd St., New York 16, N. Y.* **176**

Pipe Bender

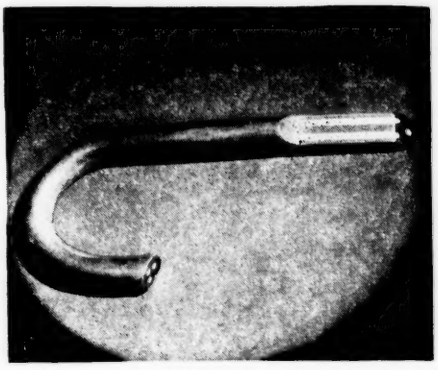
NAME—Tal copper tube bender.
PURPOSE — Designed particularly



for bending copper pipe for radiant heating installations.
FEATURES—Unit will form both unannealed hard and soft copper tubes of types K and L to a 180 deg return bend. Operator is enabled to work with a continuous coil almost close to the wall. Changeover of rollers from one size to another is said to be an easy operation. Bends can be made with ⅜ to 1 in. tube.
MADE BY—*Tal Bender, Inc., 417 N. Water St., Milwaukee 2, Wis.*.....**177**

Solder

NAME — Alpha tri-core acid-filled solder.
PURPOSE—A rosin-filled flux solder to eliminate the necessity of using separate fluxes when soldering.
FEATURES—In using this type of solder the work is heated and then the core solder is brought to the



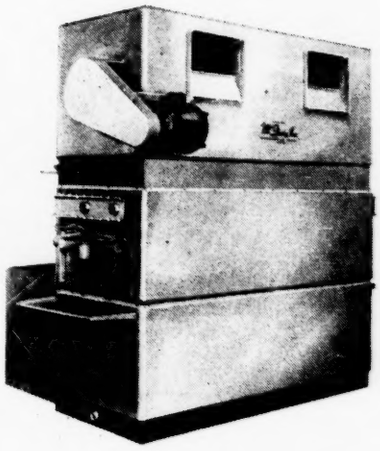
heated metal so that the flux can flow onto the job ahead of the molten solder. Makers claim that there is always the proper amount of this flux at the moment the solder begins to flow. Claims are made that this material will solder stainless steel, nickel and Monel metals.
MADE BY—*Alpha Metals, Inc., 363 Hudson Avenue, Brooklyn 1, N. Y.* **178**

Incinerator

NAME—Incinor model SC-4.
PURPOSE—Incinerator for use in hotels and institutions.
FEATURES—Unit is fired by dual gas burners of the ribbon type which apply a flat flame to a large area at the bottom of the combustion chamber. Over-all burning capacity is 25,000 Btu per hr. The grates, top section and lid are of cast iron while the outer shell of the unit is made of sheet steel. Feed door is heavily insulated with asbestos. Dual flues extend from the combustion area at the bottom to the top of the chamber on the inside and insure positive draft, regardless of the size of load. Flues also serve as heat exchangers to dry the chamber contents for faster combustion. Incinerator has a capacity of 4 bushels of garbage.
MADE BY—*Bowser, Inc., Incinerator Div., Cairo, Ill.* **179**

Air Conditioner

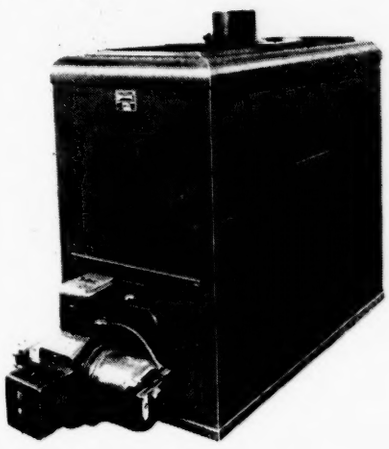
NAME—McQuay central station air conditioner.
PURPOSE—Air conditioner for year-round comfort and process work.



FEATURES—All connections are exposed and conveniently grouped. Sectionalized construction, with panels which are readily removable, facilitate any servicing that may be required. Units include ripple-fin coils with fins mechanically bonded to the tubes by hydraulic expansion. Air conditioners are provided in both floor and suspended models.
SIZES AND CAPACITIES—Eight models in sizes from 3 to 50 tons.
MADE BY—*McQuay, Inc., 1619 Broadway St., N.E., Minneapolis 13, Minn.* **180**

Furnace

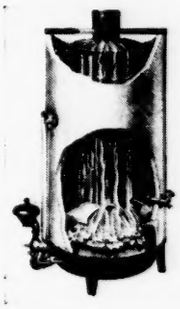
NAME—Quiet automatic winter air conditioning furnace.



PURPOSE—Space heating for small or large homes.
FEATURES—Unit is completely assembled at the factory and comes with oil or gas burner plus electronic control. Furnace, blower, humidifier and casing are all assembled. The blower may be used during the summer to circulate air throughout the house. Unit is completely sealed to prevent cellar air from leaking in and to prevent dust from leaking into the cellar.
SIZES AND CAPACITIES — 70,000, 90,000, 155,000 and 200,000 Btu output.
MADE BY—*Quiet Automatic Burner Corp., Newark 4, N. J.* **181**

Water Heater

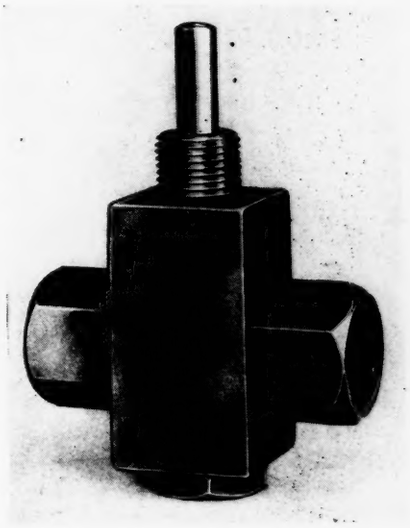
NAME—Pioneer Booster heater.
PURPOSE—For heating domestic water.



FEATURES — Interior construction features 6, 9 or 11 multiple flues, depending on the capacity of the unit, to provide greater heating surface and more rapid heating of the water. Unit has a Grayson thermostatic control, controlled gas pressure and automatic gas shut-off from the moment the pilot light goes out.
SIZES AND CAPACITIES—126, 182 and 249 gph.
MADE BY—*Pioneer Water Heater Corp., 3131 San Fernando Rd., Los Angeles 41, Calif.* **182**

Valve

NAME—Paul automatic valve.
PURPOSE—Where fluids must be turned on and off in controlled sequence as in automatic machines.
FEATURES — The light actuating force required provides quick valve action and the unit can be actuated by cam, lever, solenoid or diaphragm. Unit has only two moving parts and no springs. A precision ball is forced into the low-pressure center of the stream and hence into the valve seat. The valve automatically closes when the fluid flows through the venturi. To open the valve, the stem and yoke push the ball down, thereby rolling it



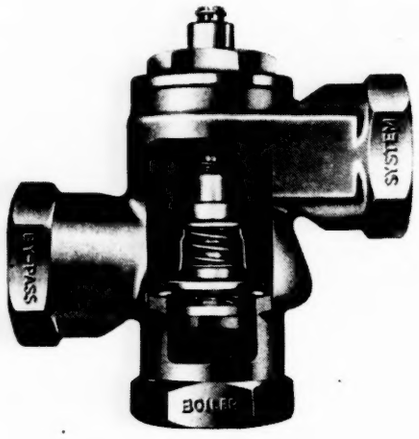
out of the seat and into a recess. When the valve is open there is no restriction to the straight-line flow. The ball is free to rotate and never seats in exactly the same position.
SIZES AND CAPACITIES—½, ¾ and 1 in. with standard NPT pipe thread connections for pressures up to 125 lb per sq in.
MADE BY—*Paul Valve Corp., 683 Third Avenue, New York 17, N. Y.* **183**

Silencer

NAME—Fiberglas blanket.
PURPOSE—For silencing operation of air conditioning units.
FEATURES—Fiberglas blankets are installed in the interior of an air conditioning unit and its adjacent plenum chamber to help absorb sound waves before they reach the ducts in an air conditioning system. Blankets have high thermal insulating efficiency and makers claim that their use greatly reduces sweating on cabinet surfaces. Special adhesives are used to hold the blankets securely to practically any surface. They are available in ½ and 1-in. thicknesses, in rolls 54 in. wide and 25 and 50 ft long.
MADE BY—*Owens-Corning Fiberglas Corp., Toledo 1, Ohio.* **184**

Water Control

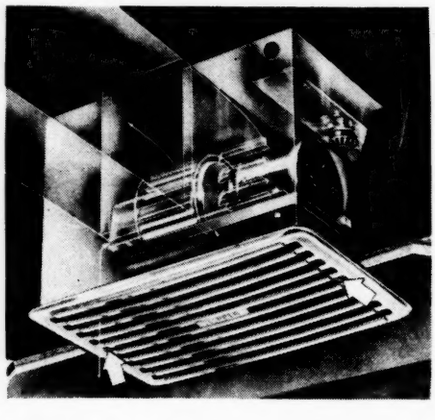
NAME—Taco Paneltrol.
PURPOSE—To thermostatically control the flow of water through radiant heating panels.



FEATURES—Temperature may be regulated between 110 and 150F. Adjustment of control is made with a screwdriver. Unit has a cast iron body with brass, bronze, and stainless steel working parts. It mixes a small portion of hot boiler water with a larger quantity of cooler return water to obtain the desired temperature.
SIZES AND CAPACITIES—While made for 1½-in. connections only, it may be bushed to 1¼ or 1 in., if required.
MADE BY—*Taco Heaters, Inc., 137 South St., Providence 3, R. I.*.....**185**

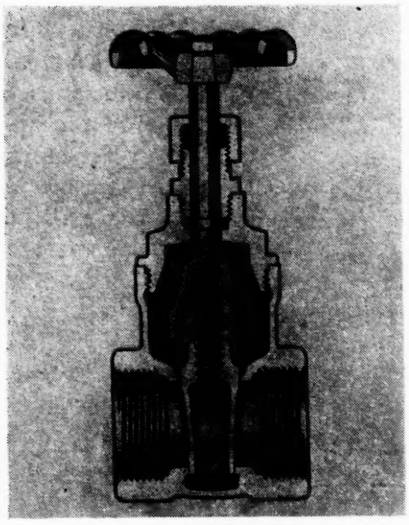
Ventilator

NAME—Clipper home kitchen ventilator.
PURPOSE—For ventilating kitchens or other small rooms.
FEATURES—For kitchen ventilation, the unit is located over the stove to trap heat and odors, and expel them out of doors. Unit completely isolates the motor from the greasy air stream, according to the manufacturer.
MADE BY—*Trade-Wind Motorfans, Inc., 5725 S. Main St., Los Angeles, Calif.* **186**



Gate Valve

NAME—Crane No. 410 screwed-end 100 lb brass gate valve.
PURPOSE—Control of fluid flow.
FEATURES—Upper portion of body is cylindrical in shape. Disc is the one-piece wedge type which is guided by long guides to assure correct seating. Valve seats are cast as part of the body in this new line of 100-lb brass gate valves. Stuffing box is packed with molded



asbestos and can be repacked while under pressure when the valve is wide open. Screwed valve is intended for use on water, steam and hot water heating lines.
MADE BY—*Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.* **187**

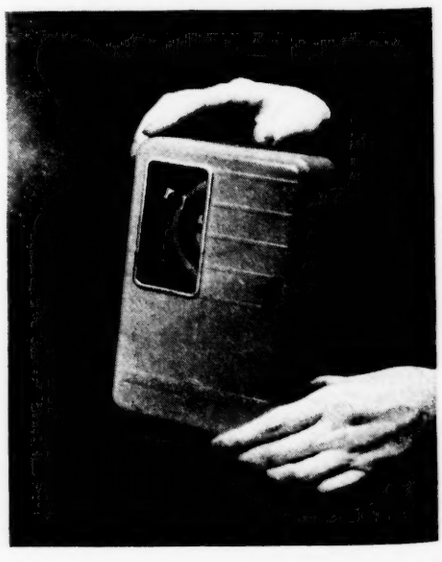
Water Heater

NAME—Speedmaster.
PURPOSE — Heating of domestic water.
FEATURES—A glo-fire burner produces short hot flame which makers claim results in smaller radiation losses. Burner is said to eliminate ignition and extinction noises. A special shield in the combustion chamber protects products of combustion from dilution. Flue way is of stainless and aluminized steel and is installed outside the tank. Makers claim that after the original heat-up, 60% of the tank capacity can be drawn at the rate of 5 gal per min with no drop in outlet water temperature. The 30-gal tank has heavy Fiberglas insulation. Unit is provided with magnesium-electro protection.

MADE BY—*Handley-Brown Heater Co., Jackson, Mich.* **188**

Time Switch

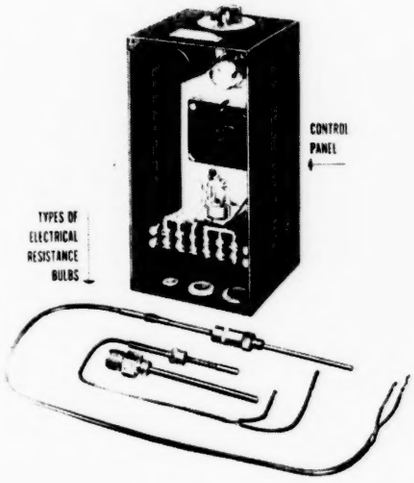
NAME—Type T-47 time switch.
PURPOSE—For on and off timing of a single circuit.
FEATURES—Unit is operated by a Telechron motor and is equipped with a large 24-hour clock dial. Adjustable switch-tripping clamps attached to the dial are used for setting the switch for automatic operation. Clamps allow a minimum setting of 5 min. and a maximum setting of 22 hr between on and off operations. Manual operation of either on or off is possible independently of automatic settings on the dial. Switch has a single-pole, single-throw mechanism with large, silver snap-action contacts.
MADE BY—*General Electric Co., Schenectady 5, N. Y.* **189**



Temperature Control

NAME—Edison temperature control.

PURPOSE—An electronically operated temperature control of the on-off type.



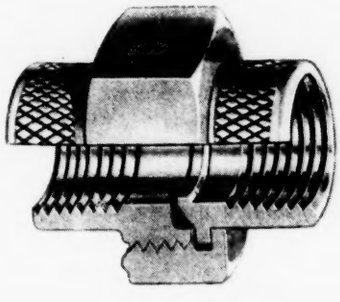
FEATURES—Device can be used to control temperatures to close tolerances in solids, gases or liquids and is available to cover the temperature range from —100 to +1200F. Supply voltage may be 115 or 230 volts, 50 to 60 cycle, a-c. Accuracy of unit is said to be independent of usual voltage variation. Because of bulb construction, response time is under three seconds. A control panel, weighing less than 8 lb, is furnished, to be located at any convenient place.

MADE BY—*Instrument Div., Thos. A. Edison, Incorporated, West Orange, N. J.* 190

Union

NAME—Gilbert union.

PURPOSE—For joining pipe lines subjected to high pressure.



FEATURES—Fittings are cut from solid steel bar stock and are machined inside and out. Brass seats are used to form a permanent seal unaffected by corrosive water. Makers claim that the ball seat design assures a positive seal even if the fitting is misaligned. Ground joint brass to steel union is rated at 300 lb pressure.

MADE BY—*Gilbert Brass Foundry Co., St. Louis, Mo.* 191

Pipe Cutter

NAME—E-Z pipe cutter.

PURPOSE—Power-driven unit for automatically cutting pipe and tubes.

FEATURES—Portable unit is designed for cutting pipe from 3/8 to 4 in. in diameter. Ball-bearing mounted cutter wheel can be removed for sharpening. Power is supplied by a ½-hp, 110-volt, motor with direct gear drive to the roliers. Gears are self-lubricating. An automatic trip-switch starts cutting operations when the cutter wheel contacts the pipe and automatically stops when the cut is finished. Adjustable roller yokes provide support for the pipe, yet permit free rotation.

MADE BY—*Quijada Tool Co., Inc., 5474 Alhambra Ave., Los Angeles 32, Calif.* 192

Thermal Timer

NAME—Ulanet manual reset thermal timer.

PURPOSE—For use as a time delay device before breaking electrical contact.

FEATURES—Unit is activated by a heater element which is wound on a bimetallic strip. When the heater element is energized, the contacts open and will not close until the Bakelite push button is manually reset. Unit can be set for any desired time delay before breaking contact. Standard model has normally closed heavy duty contacts.

SIZES AND CAPACITIES—1500 watts, 115 to 230 volts, a-c, for a timing range from 20 sec. to 3 min. Unit measures 3½ in. long, 1¼ in. wide, and 1⅛ in. high.

MADE BY—*George Ulanet Co., 414 Market St., Newark 5, N. J.*.....193

JUNE, 1948

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

161	162	163	164	165	166	167	168	169
170	171	172	173	174	175	176	177	178
179	180	181	182	183	184	185	186	187
188	189	190	191	192	193			

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Abstracts and Reviews

Publications abstracted in this department should be ordered direct from publisher.

STEAM, AIR AND GAS POWER

The authors, William H. Severns, professor of mechanical engineering, University of Illinois, and Howard E. Degler, formerly professor of mechanical engineering, University of Texas, and now technical director, Marley Company, had as their objective in the preparation of this book to provide an elementary textbook for courses dealing with heat engineering. The book was first published in 1929 and the fourth edition was recently released.

The text has been brought up to date with present practice. The most important of the new material that has been added is the data on the gas turbine. At the end of each chapter is a group of illustrative problems; most of the problems are new.

Discussions and illustrations show the underlying theory of the construction, applications and performance of modern heat-power plants and their correlated equipment.

The book is divided into 17 chapters and some of the chapter heads are: Heat power plants; principles of thermodynamics; steam and steam calorimetry; steam fuels and combustion; steam generators or boilers; steam generator auxiliaries; feedwater heating and conditioning; draft apparatus; steam engine power and economy; steam and gas turbines; steam condensing equipment; pumps; compressed air; internal combustion engines.

Steam, Air and Gas Power, by William H. Severns and Howard E. Degler. Cloth bound, 6 x 9 in., 509 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $4.75.

FLUID FLOW IN PIPES

While this book covers fluid flow in pipes with sufficient thoroughness to be rather complete, it is intended to serve as a supplementary volume to a standard text to clarify some of the dimensional phases of the field. The more difficult parts of the subject are discussed in greater length and detail than in some text books. General physical data, readily available elsewhere in tabular or graphical form, were omitted to provide more space for the discussion of important details.

It is the objective of the author, Clifford H. McClain, to fill the need for a treatment of the theory and practice of fluid flow in pipes from the dimensional viewpoint. Since the accuracy of all the calculations hinges upon the consistency of the dimensional relations used, it is hoped that the text will pass on a working knowledge of the basic principles of fluid flow and the proper expression of the several quantities involved.

The text is divided into four chapters—elements of dimensional analysis; fluids and their properties; viscosity of fluids—its theory, measurement and dimensions; and fluid flow in pipes. A number of illustrative problems are included to test one's working knowledge of the data.

Fluid Flow in Pipes, by Clifford H. McClain. Paper cover, multigraphed sheet 8½ x 11 in., 159 pages. Published by the author, 21 W. Wilmot Ave., Havertown, Pa. Price, $5.

• • •

GRAVITY WELLS — A Study of the Free Surface Around, and Interference Between, Gravity Wells, by Harold E. Babbitt and David H. Caldwell, is presented in Engineering Experiment Station Bulletin Series No. 374. It covers data that are of value in predicting the future yield of gravel wells and in determining the characteristics of water flow for such wells. Some of the subjects covered are location of free surface, area of influence, partial penetration by a gravity well, and interference between wells. Price of 60-page bulletin is 50 cents. The Engineering Experiment Station, University of Illinois, Urbana, Ill.

PIPE AND TUBE BENDING HANDBOOK—Originally issued during the war, this handbook now in its third edition, includes the latest data on the subject. Material is included on the bending of all sizes of pipe and tube made from copper and all of its useful alloys. Many of the leading types of hand benders and bending machines are discussed, and in most cases, illustrated. One of the sections of this 48-page book deals entirely with a detailed analysis of the different basic bending methods and the principles involved in each. The Copper & Brass Research Association, 420 Lexington Ave., New York 17, N. Y.

HOUSING IN AMERICA—This report is the result of studies carried on for Congress by the Joint Committee on Housing. A number of hearings were held in 33 cities and about 7,000 pages of testimony were taken. Testimony was taken from over 1,200 witnesses. Some of the topics covered in this 178-page report include: Building materials; labor factor in housing; financing; management factor in housing; special interests in housing; results and effects of war and postwar housing legislation; estimates of housing shortage. Based on this study, it is the opinion of the committee that the goal should be 1.5 million newly constructed or reconstructed dwelling units for the next two years. House Document No. 629. Superintendent of Documents, Government Printing Office, Washington 25, D. C.

DEGREE-DAYS FOR APRIL, 1948

HEATING AND VENTILATING'S 21st Year of Publication of Monthly Degree-Day Data

City	April			Cumulative, Sept. 1 to Apr. 30			Heating Season[1]
	1948	1947	Normal	1947-48	1946-47	Normal	Normal
Abilene, Texas	38	152	27	2840	2815	2061	2061
Albany, New York	543	650	549	7108	6348	6397	6580
Albuquerque, New Mexico	185	318	288	4540	4241	4258	4298
Alpena, Michigan	693	818	789	7397	7275	7662	8299*
Anaconda, Montana	784	731	756	7779	7680	7493	8357**
Asheville, North Carolina	170	190	330	3823	3946	4161	4232
Atlanta, Georgia	61	76	132	2821	2830	2890	2890
Atlantic City, New Jersey	480	481	519	4843	4287	4956	5176
Augusta, Georgia	23	32	24	2288	2175	2161	2161
Baker, Oregon	674	569	615	6285	6383	6519	7163
Baltimore, Maryland	308	302	348	4389	3945	4511	4533
Billings, Montana	511	585	534	6710	7034	6743	7119
Binghamton, New York	(a)	576	594	(a)	5892	6554	6808
Birmingham, Alabama	69	84	69	2755	2742	2352	2352
Bismarck, North Dakota	624	708	657	8944	8506	8809	9192
Block Island, Rhode Island	623	618	633	5565	4883	5311	5788
Boise, Idaho	507	469	435	5662	5633	5316	5552
Boston, Massachusetts	511	537	570	5849	5123	5800	6045
Bozeman, Montana	635	660	731	7642	7369	7724	8521**
Buffalo, New York	487	651	675	6325	6075	6475	6822
Burlington, Vermont	635	739	654	7721	7029	7238	7514
Butte, Montana	762	749	741	8240	8084	7424	8235**
Cairo, Illinois	123	186	201	3921	3722	3909	3909
Canton, New York	617	744	684	7783	7307	7686	8020
Charles City, Iowa	400	629	612	7139	6968	7364	7588
Charleston, South Carolina	36	35	36	1944	1714	1769	1769
Charlotte, North Carolina	98	103	159	3165	2982	3120	3120
Chattanooga, Tennessee	86	109	144	3212	3361	3118	3118
Cheyenne, Wyoming	608	750	720	6986	6989	6894	7466
Chicago, Illinois	396	546	518	5769	5641	5764	6077
Cincinnati, Ohio	224	294	333	4481	4318	4684	4684
Cleveland, Ohio	398	547	564	5782	5570	5935	6155
Columbia, Missouri	180	346	303	4750	4743	4900	4922
Columbia, South Carolina	45	40	63	2493	2277	2364	2364
Columbus, Ohio	306	392	420	5133	5002	5311	5398
Concord, New Hampshire	635	705	669	7489	6831	7001	7353
Concordia, Kansas	180	444	342	5400	5338	5250	5315
Dallas, Texas	32	95	9	2689	2465	2256	2256
Davenport, Iowa	313	470	453	5973	5782	6171	6289
Dayton, Ohio	350	463	396	5607	5420	5183	5264
Deer Lodge, Montana	692	633	735	7588	7238	7860	8672**
Denver, Colorado	355	552	534	5569	5569	5607	5874
Des Moines, Iowa	296	493	441	6129	6081	6266	6384
Detroit, Michigan	426	609	573	6224	5928	6264	6490
Devils Lake, North Dakota	841	760	756	9803	9332	9450	9970
Dodge City, Kansas	173	445	342	5271	5096	4988	5035
Dubuque, Iowa	336	544	489	6450	6312	6641	6790
Duluth, Minnesota	720	866	801	8876	8741	8746	9483
Eastport, Maine	812	812	786	7436	6777	7398	8520**
Elkins, West Virginia	314	371	501	5350	5453	5520	5697
El Paso, Texas	47	148	45	2908	2707	2428	2428
Ely, Nevada	667	714	(a)	7240	7000	(a)	(a)
Erie, Pennsylvania	444	593	609	5733	5505	6016	6273
Escanaba, Michigan	730	867	828	7896	7700	8118	8771
Evansville, Indiana	257	285	276	4658	4505	4244	4244
Fort Smith, Arkansas	60	144	93	3416	3303	3147	3147
Fort Wayne, Indiana	406	544	474	6141	5954	5795	5925
Fort Worth, Texas	34	104	27	2716	2513	2148	2148
Fresno, California	173	82	135	2544	2548	2334	2334
Galveston, Texas	7	18	0	1445	1407	1016	1016
Grand Junction, Colorado	364	425	384	5871	5575	5430	5548
Grand Rapids, Michigan	422	584	534	6169	5986	6361	6535
Green Bay, Wisconsin	554	727	600	7571	7263	7503	7825
Greensboro, North Carolina	174	175	210	3804	3680	3529	3529
Greenville, South Carolina	91	100	195	3145	3036	3380	3380
Harrisburg, Pennsylvania	386	393	405	5532	4910	5285	5375
Hartford, Connecticut	515	557	531	6324	5536	5834	6036
Hatteras, North Carolina	133	157	255	2418	2203	2571	2571
Havre, Montana	638	552	630	7522	8277	8187	8700
Helena, Montana	653	622	646	7470	7545	7261	7894**
Houston, Texas	8	33	0	1557	1489	1157	1157
Huron, South Dakota	424	677	570	7913	7592	7737	8004
Indianapolis, Indiana	309	392	384	5177	4984	5239	5298
Jackson, Mississippi	42	48	(a)	2293	2228	(a)	(a)
Kansas City, Missouri	149	342	306	4883	4742	4950	4956
Knoxville, Tennessee	105	115	210	3402	3566	3670	3670
La Crosse, Wisconsin	444	660	528	7562	7246	7139	7322
Lander, Wyoming	634	724	690	7334	7435	7384	7947
Lansing, Michigan	453	633	582	6677	6382	6819	7048

(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on Page 112]

Degree-Days for April, 1948 (Concluded)

HEATING AND VENTILATING 21st Year of Publication of Monthly Degree-Day Data

City	April			Cumulative, Sept. 1 to Apr. 30			Heating Season[1]
	1948	1947	Normal	1947-48	1946-47	Normal	Normal
Lewiston, Maine	655	734	693	7316	6942	7318	7707
Lincoln, Nebraska	239	473	417	5891	5657	5900	5999
Little Rock, Arkansas	59	117	78	3214	3077	2811	2811
Livingston, Montana	613	653	653	6970	7124	6638	7245**
Los Angeles, California	170	128	159	1456	1268	1414	1504
Louisville, Kentucky	213	242	264	4285	4140	4180	4180
Lynchburg, Virginia	236	244	273	4201	4050	3980	3980
Macon, Georgia	31	39	33	2334	2264	2201	2201
Madison, Wisconsin	431	617	582	7122	6758	7193	7429
Marquette, Michigan	667	922	804	7758	7719	7968	8693*
Memphis, Tennessee	92	107	96	3355	3115	2950	2950
Meridian, Mississippi	42	66	24	2332	2333	2160	2160
Milwaukee, Wisconsin	494	665	648	6754	6696	6856	7245
Minneapolis, Minnesota	454	685	570	7780	7529	7614	7850
Modena, Utah	588	562	579	6633	5946	6170	6562
Montgomery, Alabama	22	37	0	2016	1958	1884	1884
Nantucket, Massachusetts	643	649	639	5764	5118	5450	5957
Nashville, Tennessee	126	146	180	3637	3553	3507	3507
New Haven, Connecticut	566	566	543	6055	5329	5672	5895
New Orleans, Louisiana	39	3	0	1402	1219	1024	1024
New York, New York	449	453	465	5148	4617	5073	5274***
Nome, Alaska†	1843	2004	1756	10855	11003	10642	14580**
Norfolk, Virginia	216	216	246	3310	3009	3350	3350
North Head, Washington	573	424	516	4227	4160	4271	5452**
North Platte, Nebraska	274	537	486	5917	6092	6167	6366
Oakland, California	343	211	273	2885	2733	2665	3143**
Oklahoma City, Oklahoma	57	217	162	3778	3543	3613	3613
Omaha, Nebraska	263	495	414	6094	5928	6047	6131
Oswego, New York	540	662	675	6545	6140	6668	7088
Parkersburg, West Virginia	232	273	351	4615	4476	4722	4775
Peoria, Illinois	330	456	453	5832	5758	5988	6109
Phi'adelphia, Pennsylvania	370	354	378	4779	4240	4605	4737***
Phoenix, Arizona	18	21	0	1651	1278	1405	1405
Pittsburgh, Pennsylvania	339	394	423	5257	5170	5157	5235
Pocatello, Idaho	600	572	567	6591	6363	6263	6655
Portland, Maine	707	711	666	7205	6703	6771	7218
Portland, Oregon	462	291	402	3889	3718	4134	4469
Providence, Rhode Island	461	509	558	5648	4989	5764	6015
Pueblo, Colorado	309	473	456	5840	5669	5328	5514
Raleigh, North Carolina	138	136	183	3353	3056	3234	3234
Rapid City, South Dakota	483	653	594	6745	7236	6744	7118
Reading, Pennsylvania	385	389	417	5136	4677	5293	5389
Red B'uff, California	353	116	793	2945	2543	7910	(a)
Reno, Nevada	622	498	534	5798	5365	5436	5892
Richmond, Virginia	227	229	246	3880	3532	3695	3695
Rochester, New York	489	618	618	6492	6116	6472	6732
Roseburg, Oregon	509	318	411	4057	3942	4047	4428
Roswell, New Mexico	111	228	180	3927	3452	3484	3484
Sacramento, California	308	129	207	2832	2653	2600	2653
St. Joseph, Missouri	196	371	342	5385	5088	5145	5161
St. Louis, Missouri	204	287	276	4557	4386	4585	4585
Salt Lake City, Utah	461	494	453	5745	5623	5555	5555
San Antonio, Texas	20	61	0	1859	1844	1202	1202
San Diego, California	138	102	174	1526	1295	1524	1645
Sandusky, Ohio	390	542	726	5735	5432	6025	6208
San Francisco, California	343	224	294	2454	2401	2417	3264**
Sault Ste. Marie, Michigan	749	956	819	8372	8269	8448	9285**
Savannah, Georgia	19	25	0	1729	1579	1490	1490
Scranton, Pennsylvania	460	517	513	6024	5561	5958	6129
Seattle, Washington	511	331	462	4165	4035	4379	4934**
Sheridan, Wyoming	553	659	648	7094	7310	7485	8008
Shreveport, Louisiana	25	48	0	2452	2272	1938	1938
Sioux City, Iowa	331	573	489	6717	6834	6734	6898
Spokane, Washington	646	502	504	6348	6044	5989	6355
Springfield, Illinois	250	380	366	5068	5054	5317	5373
Springfield, Missouri	165	287	267	4585	4551	4416	4428
Syracuse, New York	495	610	630	6697	6198	6614	6893
Tacoma, Washington	540	383	465	4507	4384	4551	5181**
Terre Haute, Indiana	303	380	333	5313	4939	4872	4872
Toledo, Ohio	406	577	525	6192	5900	5897	6077
Topeka, Kansas	143	356	300	4982	4852	4935	4969
Trenton, New Jersey	409	408	402	5165	4592	4852	4933
Utica, New York	482	615	588	6910	5744	6543	6796
Valentine, Nebraska	391	624	561	6718	6929	6766	7039
Walla Walla, Washington	438	304	363	4703	4519	4637	4808
Washington, D. C.	265	255	348	4291	3915	4601	4626
Wichita, Kansas	120	352	252	4681	4613	4673	4673
Williston, North Dakota	694	711	669	8640	8744	8907	9323
Winnemucca, Nevada	581	484	539	5986	5661	5950	6427**
Yakima, Washington	525	343	360	5558	5400	5413	5599

(a) Data not available.
†Nome data are for March.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl

NEWS OF THE MONTH

AIR CONDITIONED CLASSROOMS

for southern climates go on test in New Orleans public school experiment.

Installation of air conditioning systems in three public school classrooms in New Orleans will be completed by the end of July in preparation for an experiment of far-reaching significance to determine how much it benefits school children, according to announcement (May 12) by George E. May, member of the executive board of the Louisiana Education Foundation, which will conduct the test. Mr. May said the installation would be completed in time to give the foundation a month to test the air-conditioning system before it is put into use in September.

• **SPLIT GRADE.**—The schools in which the air-conditioning systems are installed will operate for three years with one split grade—identical rooms except for the air conditioning in one. The plan is to install air conditioning in third grade classrooms and make scientific studies of the students through the fifth grade in both conditioned and nonconditioned rooms.

• **LOWER COSTS.**—The experiment may also prove that air conditioning cuts down building and maintenance costs. Less expensive materials could be used in construction, said Mr. May, lower ceilings, windows of a solid sheet of glass, and other changes would be practical, it was pointed out.

• **HIGHER EDUCATION.**—The project is a result of long studies by the Louisiana Education Foundation to find out why Louisiana is next to the bottom of the list of states in education achievement. The Foundation concluded that the climate must have a definite influence on education.

A semi-permanent air conditioning system, at a cost of $15,000, is being provided by the Servel Corp. at no cost to the board of education. It was announced that the corporation's New Orleans dealer, Gulf Engineering Co., would install the equipment.

LABOR PRODUCTIVITY

in construction trades responds favorably to lifting of restrictive practices.

Labor organizations in the building industry recently have taken a number of important steps to increase productivity by bringing labor practices in closer accord with modern building techniques, according to a study by economists of the Construction Industry Information Committee, Melvin H. Baker, chairman of the committee, announced.

Many international unions have moved to eliminate ingrained industrial practices that have retarded technical progress, restrictions on the numbers of apprentices have been greatly relaxed, and cooperative machinery has been set up to settle jurisdictional disputes, Mr. Baker said.

• **NEW METHODS.**—The International Brotherhood of Electrical Workers has stated its approval of the use of power tools and labor saving devices; the carpenters' union imposes no restrictions on the use of power tools by its members, provided they are used under conditions safeguarding the worker; the plumbers' and pipefitters' union has emphasized its consent to the cutting and threading of pipe at the contractor's shop by its members and to their use of power tools for cutting and threading pipe of any size; the International Brotherhood of Painters permits the use of spray guns where adequate provision is made for protecting the health of workers, and has removed objections to the installation of window sash which have been glazed in the factory.

• **APPRENTICES.**—Labor unions in almost all crafts are cooperating with management in increasing the number of apprentices and in providing for their training, with the result that the number of apprentices in the building trades now is three times greater than it was two years ago. Fully 115,000 apprentices now are in training and efforts to expand the program are continuing.

The president of the Bricklayers, Masons and Plasterers' International Union has urged all local unions to permit as many new apprentices as are needed to meet future building needs.

The results of the apprentice program will be a larger and better trained labor force than was available in former years and a labor force which is more productive because of a lower average age.

• **JURISDICTION.**—The Building and Construction Trades Department of the A. F. of L. and employer associations have devised a new plan for settling jurisdictional disputes which promises to be generally acceptable both to management and labor and to have an effectiveness never achieved in earlier attempts to solve the problem.

A basic attack on the causes of jurisdictional disputes has been made in the pipe trades where a combination of the crafts of plumber and pipefitter (steamfitter) has been undertaken by the international union and in some localities is already complete.

• The Industrial Hygiene Foundation has arranged with Elizabeth Steel Magee Hospital, part of the University of Pittsburgh Medical Center, to occupy a laboratory building providing facilities for expansion of the foundation's *basic researches in industrial health*, especially in toxicology, instrumentation, and engineering. The building is located near the foundation's headquarters at Mellon Institute.

DISTRICT HEATING

is examined from all angles at NDHA annual meeting in St. Louis.

The 39th Annual Meeting of the National District Heating Association took place May 18 to 21 at the Hotel Statler, St. Louis, Mo.

President Robert D. Martin called the meeting to order on the morning of the 18th at a session devoted to annual reports of association committees. The sessions which followed included technical papers under the seven general classifications of NDHA activity: commercial relations, rates and regulations, sales development, meters and accessories, research, steam station engineering, and distribution.

• **OFFICERS.**—Included in the final session was a ceremony inducting the following officers to serve for the 1948-1949 term: Henry L. Martin, Boston Edison Co., president; David W. Loucks, Allegheny County Steam Heating Co., 1st vice president; George H. Tuttle, The Detroit Edison Co., 2nd vice president; Alfred T. Veness, Rochester Gas and Electric Corp., 3rd vice president; and John F. Collins, Jr., secretary-treasurer.

• **TECHNICAL PAPERS.**—Following are brief extracts of four of the papers presented at the various sessions (a more complete presentation of one paper, *Corrosion of Underground Steam Line Supports*, by Leo F. Collins, Frank J. Schlachter, and Glen D. Winans, appears on page 83 of this issue):

Forecasting of New York Steam System Peak Loads, by Thomas P. Brown, Jr., New York Steam Corp., was a study of factors affecting the accurate forecast of peak sendout loads during the heating season. Forecast of daily loads is important economically because of the need for scheduling leased plants and other peak load capacities. Previous methods of forecasting were based on a statistical correlation of 6 a.m. temperatures with recorded peak loads. At New York Steam, it was decided to re-examine the whole basis of determining heat sendout loads. Analysis showed that while daily loads do follow the 6 a.m. temperature roughly, there is considerable scattering of the data and apparently three other factors have sufficient influence to warrant investigation. One such factor is the variation with days of the week. Mondays show consistently high sendout loads with succeeding days in descending order of demand and considerable drops on Saturdays and Sundays. Another factor is an apparent lag in heating between an abrupt temperature change and the change in demand. This lag has its effects in both abrupt cooled and warm changes. A third factor is observed to be the number of sunshine hours. This affects the shape of the load curve, reducing the load in afternoon hours on Sundays. Wind velocity also has a distinct effect upon heat load.

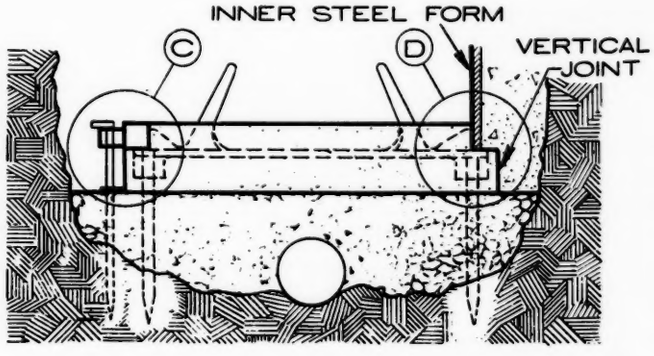
A review of observed loads in relation to these factors resulted in tables and charts of correction factors which can be applied to circumstances as they exist on a given day at 6 a.m. A chart has been drawn which shows the true relationship between peak sendout and 6 a.m. temperature. This chart is applicable only to certain conditions of previous mean temperature, average humidity, and average wind velocity and is drawn to the established normals for the New York area. Its readings can be corrected for actual conditions on any given day.

Comparison Between Air and Steam Testing of Shuntflo Meters, by W. G. Gillim, New York Steam Corp., was a comparison of methods of testing meters with air, as used by Builders-Providence, and the steam calibration tests used by New York Steam. Purpose of both tests is to determine the accuracy of registration of shuntflo meters over the entire operating range.

The paper presented basic principles and calculations used in both methods and showed that correction factors derived by each method differed by less than 1%. The conclusion was that any difference in accuracy between the two systems is insignificant, and selection of one method in preference to another would depend on the weight of other factors such as complexity of equipment, availability of steam, rapidity of test, training of personnel, etc.

American and European Viewpoints on the Combined Operation of Electric and Steam Service, by Ward F. Davidson, Consolidated Edison Co. of New York, Inc., re-examined technical and economic factors and recent shifts in their relative importance in any decision to combine or separate steam and electric generating services. A study of four systems, those in New York, Rotterdam, Paris, and Copenhagen led to the general conclusion that the best balance is reached when the base load of the district heating system is supplied by a combined steam-electric station and the peak load is supplied by boiler plants as near as possible to the principal load centers.

Improved Base Construction of Concrete Conduit for Underground Steam Mains, by F. J. Schlachter, the Detroit Edison Co., was a description of a new conduit base and a comparison of this base with previous construction. Purpose of the new base was to improve the construction joint between the base and side walls of concrete conduit to keep water from entering the conduit. The new construction uses a 14 gage steel



New conduit base construction with steel curb forms. Details (C) shows curb form in place. Detail (D) shows curb removed and sidewall form and concrete in place.

3 types of Systems

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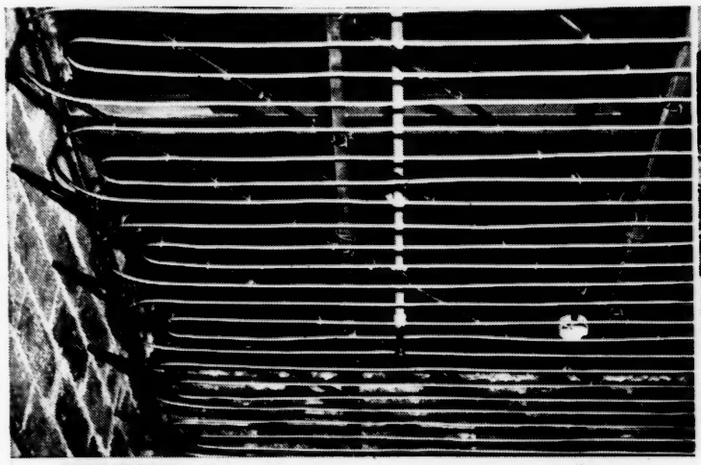

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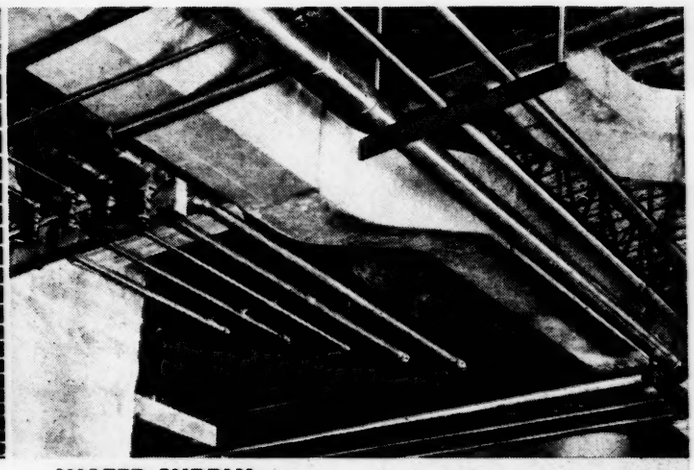

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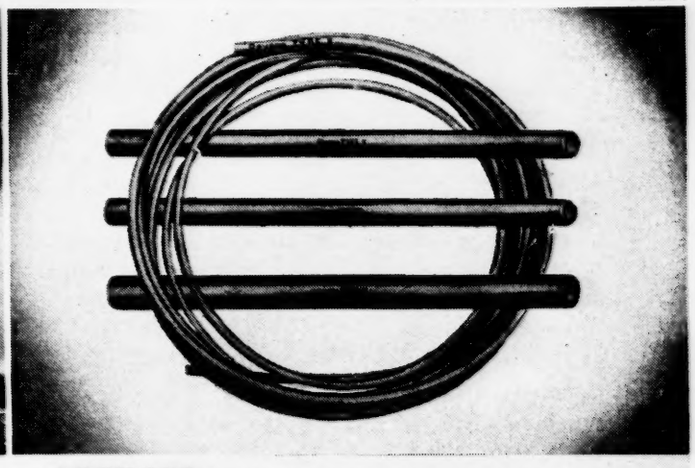

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curb 10 ft long in place of the wooden keyway formerly used in fabricating forms for the concrete conduit base. These steel forms are removed after piping installation is completed and before steel inner forms for the side walls are placed. The result is a vertical joint of the base with the side wall rather than the former horizontal joint.

CONSTRUCTION FUTURE

analyzed by construction company official at ASCE annual meeting.

A three-way look into the future of construction to find at least partial answers to the questions:

(1) What's the job ahead of us?

(2) What's available to do it with?

(3) What methods can be used?

was taken by J. P. H. Perry, vice president of Turner Construction Co. at the annual meeting of the American Society of Civil Engineers. The following paragraphs are extracts of Mr. Perry's talk reported in *Civil Engineering*.

• **BIG JOB.**—The job ahead is staggering in its immensity. Outside of industrial construction for war purposes from 1940 to 1945, and a considerable volume of industrial work since V-J Day, building construction in the United States in general has been at a standstill since the middle 30's. On Manhattan Island, for example, there have been but two office buildings worth mentioning built in the last ten years, namely, the Standard Oil office building at Rockefeller Center and the new Tishman Building at 57th Street and Park Avenue. The writer knows of no hotels or churches and but few hospitals that have been built in the last decade. Apparently the same has held true in Chicago and for a longer time.

• **NEXT DECADE.**—There are influences currently working which should accelerate or enhance the building construction to be done in the next decade or so. Among them are:

(1) The need for veterans' hospitals. The writer was astonished to hear authoritatively the other day that the peak occupancy load in the veterans' hospitals today is made up of veterans of World War I. These are men in their 50's with whom life has caught up and who claim aid of the Veterans' Administration. It is not hard to think what the hospitalization problem for veterans will be when the age of World War II veterans reaches the same point.

(2) The educational needs of the country for schools and colleges are well known. There is hardly a university or college that hasn't a large building program.

(3) Universal military service or, failing that, a greatly enlarged permanent military organization in this country will require new facilities.

(4) Private and government hospitals, other than for veterans, have to be built in great quantities.

(5) Greater than any of these specific elements tending to increase the load on the building industry is the accelerated birth rate. The following figures are taken from a reliable source:

Prewar births	about 2,200,000 a year
1947 births	3,730,000
Prewar marriages	1,400,000 a year
1947 marriages	1,900,000
1947	1,250,000 new families

We have about 10,000,000 more people than had been expected. Population is now 145,000,000, a figure which it wasn't expected to reach until the early 50's. Fifty years hence there will be another 30,000,000 people or more.

• **ERP.**—Another factor influencing this picture, and greatly so, is the apparent determination of this country to play big brother to all the world. ERP's effect on our national economy cannot but be great. The resulting exports will be tremendous and this should mean an expansion of our national productive machine which, as we have seen in both World Wars, means a great volume of building construction.

Overriding all these elements which tend to expand and accelerate the building needs of the country is the ever higher scale of living and the rapid working of obsolescence in this optimistically minded country. We like the "new look" in our buildings as well as in our women.

• **COSTS.**—Some may say "Amen" to all this but with tongue in cheek, wondering whether high costs will cancel out these influences—or dreams as they might be called. Granted that costs are high, it is probably a fact that this country has had its biggest building booms in the face of the highest costs. Look at the great expansion in the 1920's. The building cost index from 1920 to 1929 averaged about 200 on a base of 100 for the year 1913, or about twice the prewar index. Today our cost index is 400 against a pre-World War II index of about 190, or a little over twice prewar. In the writer's experience of some 40 years it seems to be a fact that if there is need for buildings and the general business outlook is reasonably serene, high costs do not stop building.

• **CLOUDS.**—It is only proper perhaps to temper this optimism as to the job ahead of the construction industry with a suggestion that some of the clouds now on the horizon tending to slow down the industry might develop into real storm warnings, which might make 1948 a relatively poor building year.

One of these clouds is the possible restriction of credit starting in the Federal Reserve System and working on through the banks. Interest rates are tightening. There is a shortage of working capital in many companies in the country. Loans for speculative buildings are harder to get. Should this movement grow, it would result in some unemployment and a minor reduction in prices. However, it might well be that this trend would be offset by the government's

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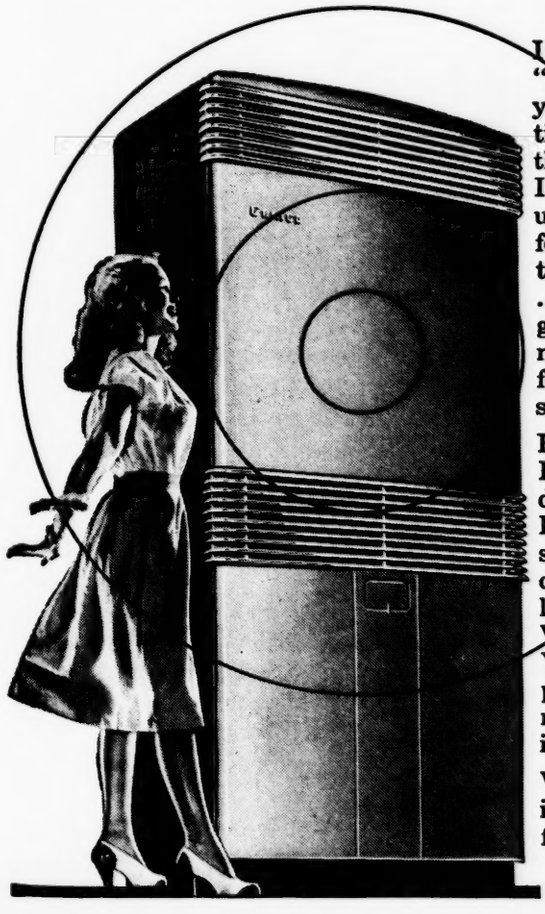

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stepping in and releasing a lot of public works to offset any construction depression.

The other cloud on the horizon is the Russian picture. Should the present armed truce be terminated in an unfavorable way, private construction would probably freeze for a while.

• **WAGES AND PRODUCTIVITY.**—In connection with this matter of costs it may be of interest to mention the writer's reaction to the very general opinion held by laymen that high wages and non-productivity of labor are solely responsible for the high cost of buildings today. The facts appear to be somewhat different. No small part of the higher costs today is for the satisfying of the owners' or tenants' demands for air conditioning, acoustical treatments, improved intercommunicating systems, Thermo-pane windows, universal floor ducts, aluminum or stainless steel sash, adjustable partitions, more fire-protective methods and a greater use of fine stone.

It is probably true that all engineers in construction have had the same experience as the writer, namely, that most of their friends have picked on the bricklayer for the number of bricks he doesn't lay and for the high hourly rate he is paid, seeming to imply that if the bricklayer situation could be corrected buildings would be cheaper. Unless these statements are interpreted as purely symtomatic and applying actually to all skilled trades and not merely to the bricklayer, it is fallacious to regard them as "signs of our times." The cost department of the Turner Construction Co. has released the following figures illustrating this point:

In an estimate totaling in excess of $20 million for an office building in another city, $216,000 was recently allowed for brick masons and $73,000 for stone masons setting the limestone exterior. The combination of these two mason payrolls is only a little over 1½% of the entire cost of the building. On a $4.6 million factory just finished in New Jersey, the total paid to bricklayers was $107,000 or a little over 2% of the total cost. On a 25-story hotel built in Manhattan some time ago, bricklayers were paid $95,000 or about 3%, and so it goes.

It would take a phenomenal reduction in bricklayers' wages and a similar increase in productivity to materially reduce the cost of a modern building.

As a matter of fact on another job it was found that, if all the on-site labor, from the first pick in the ground to the last bit of paint and putty, were eliminated, the cost of this finely finished building would be reduced by only about 16%. The high costs of buildings go right back to the mines and the forests.

• **WHAT'S AVAILABLE.**—We have looked at the job that is awaiting the building industry. We come now to the second of our "looks," namely, the materials and labor probably available.

Currently building materials are not too hard to get. If the demand is anything like as great as the foregoing would indicate, it appears that the amazing productive capacity of America as demonstrated in World War II will be able to satisfy all demands and not too tardily. Similarly with labor. While at the moment in certain areas there are shortages of skilled mechanics, it is certain that labor will flow to building work though perhaps at a price. American labor leaders are above all things not stupid and if there is money to be made men will be found to do the work.

In the future the writer hopes to see stronger building trade unions, unions able to maintain discipline and to eliminate or strongly control jurisdictional disputes, the current real curse of the building industry.

• **NEW MATERIALS.**—It is more interesting, perhaps, to speculate on what may be new in the way of building materials. Are lightweight metals, enameled metals, high-tensile-strength glass, plastics and plywoods going to play a big part in the buildings of the future?

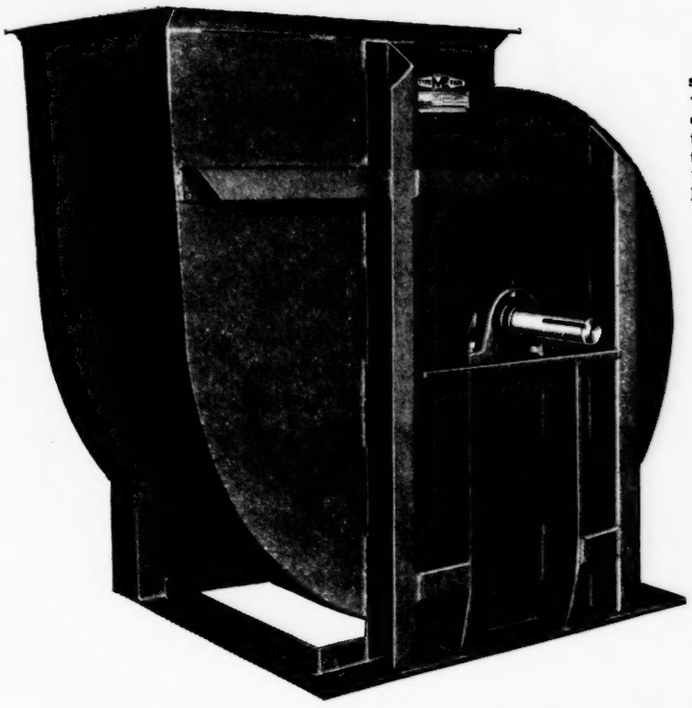
Are we going to be able to reduce the weight of our buildings so as to approximate what has been accomplished in mobile powered units? Can the aluminum and magnesium manufacturers, given sufficient demand, produce structural shapes and floor panels at a price that will compete with structural steel?

One of the great changes that may be expected is the doing away with masonry walls, partly because of the opinion held by the public, and even by architects and engineers, about bricklayers. We will probably come to metal skin buildings. One is already contemplated on Park Avenue, New York, and the United Nations Headquarters, it is understood, have made elaborate studies of metal skins for their proposed buildings. The use of high-efficiency insulating materials, such as Vermiculite, as a backup for these skins, opens inviting vistas. High-tensile-strength glass, greater use of welding, plastics, phenol glues, all have a bearing on the building of the future.

• **METHODS.**—The third projected look ahead has to do with methods to be used on future buildings. It appears that there is more chance for accelerated improvement here than in the use of new materials. The example of what was done in the shipyards, particularly on the West Coast, during the war, cannot be ignored. The greatly increased use of splendid mechanized equipment by their brothers, the heavy construction contractors, will not let builders' consciences rest easy. How much use may be made of television for management control of large jobs or radar in helping to solve foundation problems remains to be seen.

It should not be too difficult to persuade labor to permit increased mechanization of building erection and off-site assembly—in other words, prefabrication. The use of packaged units that can be set by powerful mobile hoisting equipment should reduce costs. Such units include bathrooms, kitchens, and power equipment in basements. This procedure has been used with refrigerating units; why not elsewhere? If the shipyards could do what they did in adopting preassembled units, there is no reason why this method cannot be employed in the building game.

As the years go by, building contractors will, the



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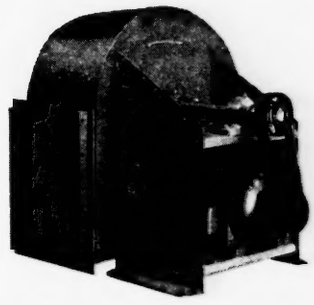

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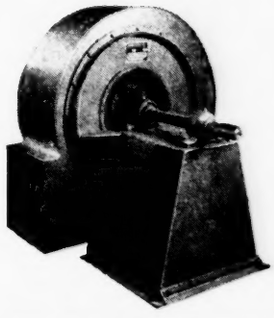

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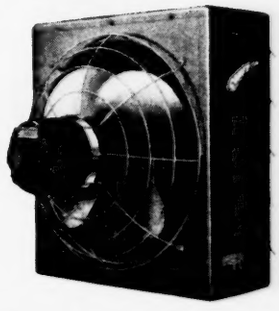

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writer believes, tend to become more and more professional, perhaps more like the guilds of the 17th and 18th centuries. Contractors will become construction managers, working largely on a cost-plus basis through an increasing number of highly specialized subcontractors. It appears also that the engineer will become more dominant in the design of industrial buildings.

Probably the construction industry will have increasingly larger building units to construct. Radio City, the proposed United Nations Headquarters, the Pentagon, the Metropolitan Life Insurance Company's housing projects, both in the Bronx and on the lower East Side of Manhattan, industrial plants such as Oak Ridge and Hanford—these are but indications of the future. There are many historical precedents. One has but to think of the Louvre, Versailles, the imperial palaces in Russia, the great European cathedrals, the Escorial near Madrid, to realize that as people get security and power they become monument builders.

DUAL FUEL HEATER

uses gas for mild weather and oil for peak loads in effort to relieve stresses in oil, gas, and burner markets.

Automatic domestic heating equipment, which utilizes natural gas during mild weather and switches to fuel oil in severely cold weather, has been perfected by the Midwest Research Institute, on a research project sponsored by The Gas Service Co. of Kansas City, Mo. The newly developed equipment will utilize gas and fuel oil efficiently, either separately or in combination in the same unit. Experimental results indicate the equipment will bring relief to the serious peak-load problem of the gas pipe line systems and the home heating consumer will be assured of adequate heating services at all times.

• **PROBLEM.**—About two years ago there was brought to the institute a problem encountered by gas distributing systems in supplying gas for home heating use during periods of severe weather conditions. A careful analysis of the problems presented indicated that a permanent answer was not to be found solely in the increasing of pipe line and distribution facilities. Due to the fact that changeable weather conditions bring about such increased demands for heating fuel during a few cold spells, the investment in gas production and distribution facilities to meet such peaks may be excessive as more and more homes install gas heating equipment. Also serious delays are often encountered in increasing such distribution facilities, which adds to the difficulties of solving the problem immediately.

• **SOLUTION.**—In view of the difficulties of supplying gas as it is needed for home heating purposes, the ultimate solution appeared to be the use of standby equipment in the consumer's home. With few exceptions there has been no general use of individual standby equipment because of mechanical difficulties and extensive changes required in the combustion unit. It became necessary to conduct a great deal of basic research on ways and means of combining the two fuels in the same unit.

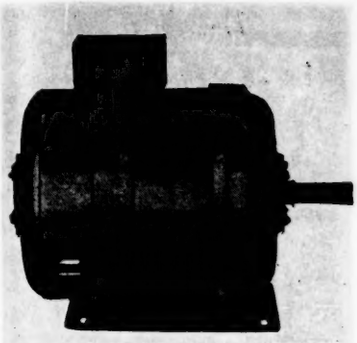
The complexity of the problem required extensive development work before models were perfected and put into use during the past season. Twenty-five units were installed in private homes and, with only minor adjustments, the performance of all units was excellent. Based upon the tests obtained with the original installations, 10 to 25% oil in the total fuel requirements will relieve both the severe gas shortage during cold waves and the peak delivery problems imposed on the oil companies and their distributors.

The Institute's engineers report the efficiency of the new gas-oil unit has been carefully tested and has been found to be equal to that of existing oil and gas units manufactured separately. Gas is burned in a conventional manner, but a new and different oil burner has been developed which is built into and around the gas system so that many parts are interchangeable. Parts performing one service in the gas cycle will also perform a service in the oil cycle, thereby eliminating a great many parts which would be required if a separate gas burner and oil burner was required in the same furnace. The equipment is not a gas burner and an oil burner, but consists of a single unit designed to burn both fuels.

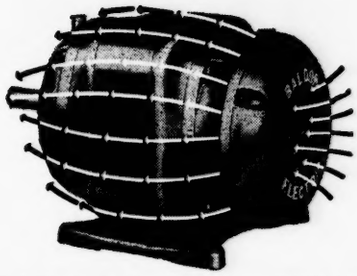
• **VAPORIZER.**—The Institute's development work on the oil burner has resulted in an extremely simple method of vaporizing the oil, a method in which the oil flows into a shallow pan where it is heated and evaporated by a small gas flame. The vaporized oil mixes easily and well with air to give a good combustible mixture which can be burned and controlled efficiently. The amount of gas required to vaporize the oil is negligible compared to the amount of gas required to heat a house, the real heating value coming from the combustion of the vaporized oil. In the event, however, of a complete gas failure the new equipment will still operate efficiently.

Attempts to obtain a combustible mixture by vaporizing oil with heat and then mixing it with air have been made many times, but the present development has resulted in the first really practical, low cost, self-cleaning and odorless burner.

• **OPERATION.**—Operation is entirely automatic. The consumer merely fills his oil tank during the summer months with about 275 gal of fuel oil. The burner is lighted in the fall and all that remains for the consumer to do is to adjust his room thermostat to the desired temperature. An outside thermostat switches over from gas fuel to oil fuel at a predetermined temperature and automatically switches back again to gas as soon as the weather has moderated. The user is protected against any possible low pressure period resulting from a short gas supply and the pipe line system is relieved of a serious peak-load problem during



Open, drip-proof construction; 1/6 to ½ h. p., 1 phase, 3 phase and Direct Current.



Arrows indicate forced air-movement over ENTIRE EXTERIOR of BALDOR STREAMCOOLED Motor.

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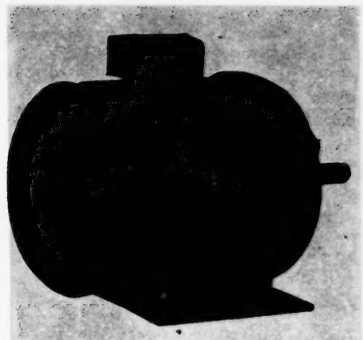

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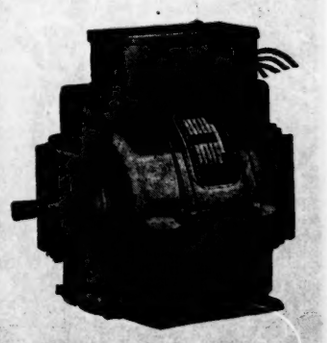

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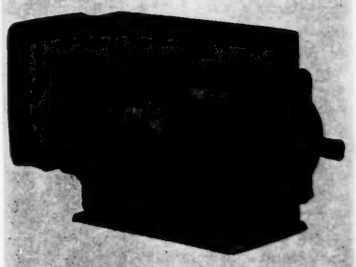

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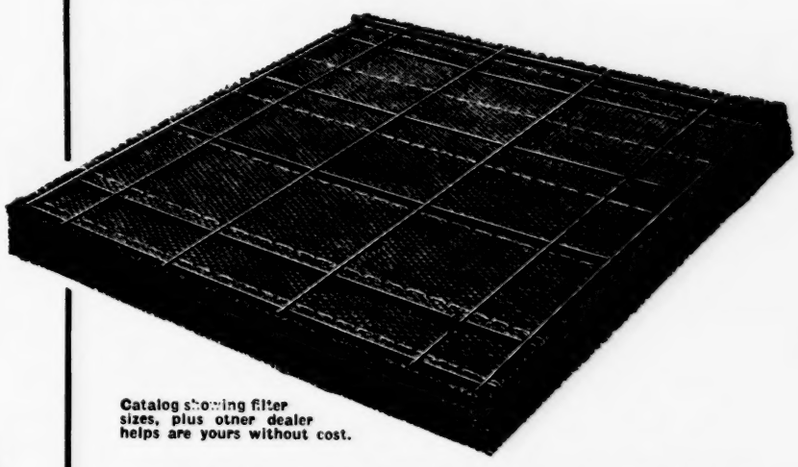
THE exclusive self-seal edge of the Research Filter prevents the by-pass of unfiltered air. All of the air must go through the filter, where dust, pollen and bacteria are scrubbed out by thousands of tiny baffles. For efficient filtering air filters should be replaced at least twice each year.



Catalog showing filter sizes, plus other dealer helps are yours without cost.

RESEARCH AIR FILTERS trap 93% of the dust, 99% of the sneeze-producing pollens, 91 to 97% of the dust borne bacteria from the air as it travels through the furnace. For summer comfort, suggest to your customers that furnace blowers be kept in operation.

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MADISON 10, WISCONSIN

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Serves
WITHOUT
ADJUSTMENT
on low...to commercial...to
air conditioning temperatures

● With a half-ton capacity A-P Model 207 Thermostatic Expansion Valve in your service kit, you're all set for an amazingly wide range of valve applications. You can install that valve — *without* adjustment and without changing or exchanging any parts — on anything from low temperature sharp freezers, ice-cream makers, and dispensing cabinets to medium temperature display cases, and reach-in boxes, and up through the entire air conditioning temperature range. And you can depend on maintaining constant superheat at all these suction temperatures. No wonder the A-P Model 207 is the favorite replacement valve among service engineers today. They have long ago proved its versatility in handling more of the small-system applications (¼ to ½ ton Freon-12). They have learned to rely completely upon its greater accuracy, supersensitive response, durability and control dependability that mean "performance-insurance" and customer satisfaction.

Standardize on the A-P Model 207 for all your small-unit needs. With its liquid charged power element, it can be installed in any position or ambient temperature, and is easier to adjust, inspect and service. For details, see your Wholesaler, or write for bulletin E-131 or condensed catalog.

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cold waves, making an ideal fuel combination for both consumer and gas supplier.

• **PRODUCTION.**—The simplicity of design makes the unit appealing from the production standpoint and it is believed that sufficient quantities can be produced in time to at least relieve the peak-load gas and oil problems of the coming winter. Manufacturing estimates show the allowable selling price of the unit will probably be less than that of a comparable oil burning unit because of the small oil tank required.

The Midwest Research Institute is the exclusive licensing agent for the equipment patents. Manufacturers will be licensed on a very liberal and non-exclusive basis so as to stimulate production and make the unit available to as large a number of persons as possible.

SHALE PROCESSING

is most likely source for synthetic fuel, according to Gulf vice president. Loss of middle east oil might bring rationing.

Production of petroleum from shale at present offers a logical approach to the problem of manufacturing synthetic gasoline and Diesel fuel, R. M. Bartlett, vice president of Gulf Oil Corporation, told a convention of the Fuel Oil Distributors of New Jersey. Mr. Bartlett described synthetic fuel research as urgent to conserve U. S. crude oil reserves and as insurance against the possibility of foreign supply being cut off by war.

• **RATIONING.**—Any break in our relationship with the eastern nations, resulting in loss of Middle East crude oil, he asserted, might immediately necessitate rationing, far deeper than ever before, if we attempted to still supply the countries to which we are committed under the European Recovery Plan. Present world demand for—and production of—oil are about equal, but demand is steadily rising.

• **ECONOMY.**—At present, Mr. Bartlett said, production of synthetic fuel from natural gas has the disadvantage of losing about half the heat value of the gas in the process. The production of motor fuels from coal is more handicapped, for about 60% of the heat value of the coal required is dissipated in the process. In addition, the plants for both processes are costly and would consume large quantities of steel.

Development of synthetic manufacture of petroleum fuels from shale currently appears quite logical, Mr. Bartlett stated. Shale is not suitable for any other purpose. Therefore, any fuel recovered from it represents a net addition to our national fuel resources, with no waste involved.

• **RESEARCH.**—Present research projects into synthetic production of petroleum fuels will be completed in about three years. The building of commercial plants, Mr. Bartlett recommended, should be delayed until they can be considered in the light of the technological advances made in that period.

BEND COLD PIPE FAST, RIGHT ON THE JOB

with a GREENLEE HYDRAULIC BENDER

Cut costs, speed piping installations this efficient, easy, economical way . . . make "on the job" bends in pipe up to 4½" with a GREENLEE Hydraulic Bender.

Simple to operate, easy to carry, set up, and shift from job to job . . . lets you bend pipe exactly where and when you want it. With a GREENLEE, *one man* makes smooth, accurate, uniform bends in a few minutes. You save greatly through elimination of many manufactured bends and fittings. And, in timesavings alone, the GREENLEE pays for itself quickly.

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All copper spiral fin tube construction with the tubes formed or heat permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS

A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

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A time proven heating unit, modern streamlined in design, quiet, yet its rugged construction adapts it to all types of installations, guaranteed for use on No. 150 p. s. i. steam pressure. All copper heating element, individual spiral fin tubes free to expand without strain on joints. Standard motors with standard bases used. Wide range of capacities.

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When fan is operating, clean, cool, fresh air is drawn through vent pipe from *outside*—circulated through motor, then exhausted from front of motor. Motor stays clean, cools itself—no foul air reaches it to interrupt service, shorten its life. It's tested. It's proved. It makes sense. Get complete details from your nearby ILG Branch Office (consult classified directory) or send coupon for free copy of new ILG Condensed Catalog and Data Book.

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• **MIDDLE EAST.**—Meanwhile, to keep production up with the demand, Middle East transportation facilities must be rapidly expanded, Mr. Bartlett asserted. A tremendous pipe-line program is now being launched by the oil industry for that purpose.

At present Mid-Eastern pipe lines are carrying about 100,000 barrels of crude oil daily from Iraq to the Mediterranean. Now under construction are several other lines. Eventually it is expected that about 1,000,000 barrels per day will be handled by such facilities.

This program will save 2,500 to 3,000 miles of water transportation. However, pending the completion of these lines there probably will be insufficient tankers to take care of world demand. The building of a large number of additional tankers will have to be undertaken.

In view of the present shortage of steel, Mr. Bartlett asserted, the following important advantage lies in the development of Middle East production:

For each ton of steel used, from five to ten times as much oil can be produced in countries outside the United States as can be produced domestically with the same amount of steel.

The reason for this is the comparatively shallow oil fields from which the Middle East oil comes, and the tremendous volume of oil per well. The average daily production of crude in the United States is about 12 barrels per well; in Venezuela, about 250 barrels; and in the Middle East, about 4,000 barrels.

SYNTHETIC FUEL LABS

dedicated by Bureau of Mines at Bruceton to pioneer coal-to-oil conversion.

Dedication of the Bureau of Mines new $3 million synthetic liquid fuels laboratories and pilot plants at Bruceton, Pa., 13 miles south of Pittsburgh, was held on Friday, May 21.

• **PROCESSES.**—Two basic processes of German origin for converting coal to oil are under study at the new Bruceton laboratories, built under the authorization of the Synthetic Liquid Fuel Act, the gas synthesis or indirect Fischer-Tropsch process, and the direct hydrogenation of coal or Bergius process. As improved by the Bureau, these are complementary rather than competitive processes. Although coal is employed as the raw material in both, the liquid products that each process is best adapted to produce differ, varying from heavy fuel oils to aviation gasoline.

With facilities for research ranging from "test-tube" to pilot-plant scale, the laboratories are an integrated unit and provide essential collateral facilities for analytical work, engineering design, drafting, and service.

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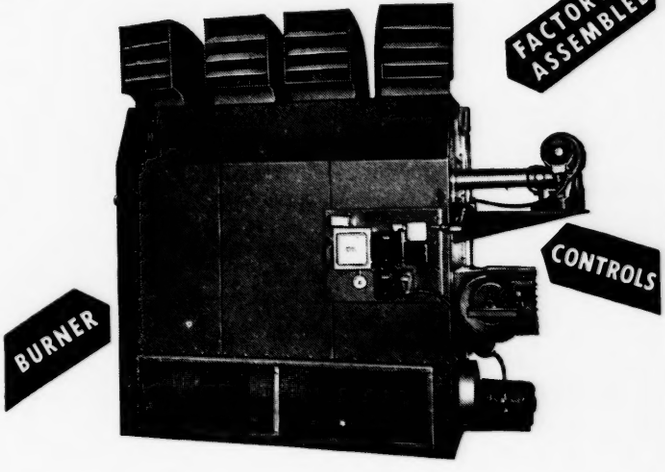

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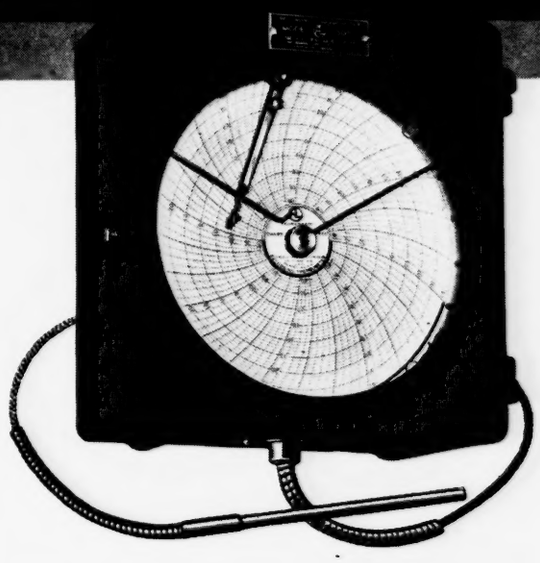

Model "500" is equipped with capillary tubing for remote reading. Priced from $37.50

THIS Auto-Lite Recording Thermometer is designed for utmost efficiency and dependability. Its vigilant recording of continuous operating cycles furnishes money-saving proof of temperature behavior. 6-inch chart with sub-divisions uniformly spaced. Model "500" Recording Thermometer is not affected by altitude or by the temperature of the room in which it is located. All readings represent true temperatures at the point where the bulb is inserted. Write for illustrated catalog describing the Recorder and other styles and types of Auto-Lite thermometers.

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SHAFCO SUSPENDED OIL-FIRED UNIT HEATERS

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WANT to cut new construction costs? Want to "add" 50, 100, even 200 feet of floor space to existing facilities? Then best you get acquainted with SHAFCO Suspended Oil-Fired Unit Heaters. They "hang" overhead . . . up in the air and out of the way . . . leaving space below free for useful, profitable occupation. And talk about heating efficiency! SHAFCO is tops! . . . 85% by actual tests . . . due to its exclusive, patented "counterflow" principle of air and heat. Installation? Quick and easy . . . because SHAFCO Heaters are compactly designed, simply assembled. Built-in plenum chamber eliminates makeshift "on-the-job" finishing. Heavy duty blower unit assures efficient heat circulation with minimum duct-work. Long-lasting? You bet! SHAFCO maintains the highest standard of quality throughout . . . with heavy gauge steel construction that really stands up under heat. No strains, no warping, no buckling! And SHAFCO Heaters have been thoroughly proved in use over 10 years successful application by major oil companies.

Models available from 100,000 to 400,000 B.T.U. to cover a wide range of commercial and industrial installations.

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ROOM COOLERS

defined by Bureau of Internal Revenue for taxing application.

As a result of long negotiations between Air Conditioning and Refrigerating Machinery Association and the Bureau of Internal Revenue, Acting Commissioner of Internal Revenue William Sherwood has advised William B. Henderson, vice president of ACRMA, that the following definition of self-contained air conditioning units has been drawn up for the taxing application of Section 3405 (c) of the Internal Revenue Code.

A self-contained air-conditioning unit, within the meaning of section 3405 (c) of the Internal Revenue Code, is a factory-made encased assembly primarily designed for free delivery of air and for installation in a window or in front of a window which (1) contains means for moving outside air through its condenser, (2) includes means for cooling, dehumidifying, and circulating the air of a room, and (3) has a total motor horsepower of less than one horsepower or a total cooling capacity of less than 10,000 Btu per hr at standard American Society of Refrigerating Engineers test conditions as set forth in ASRE Circular No. 16 dated June, 1940.

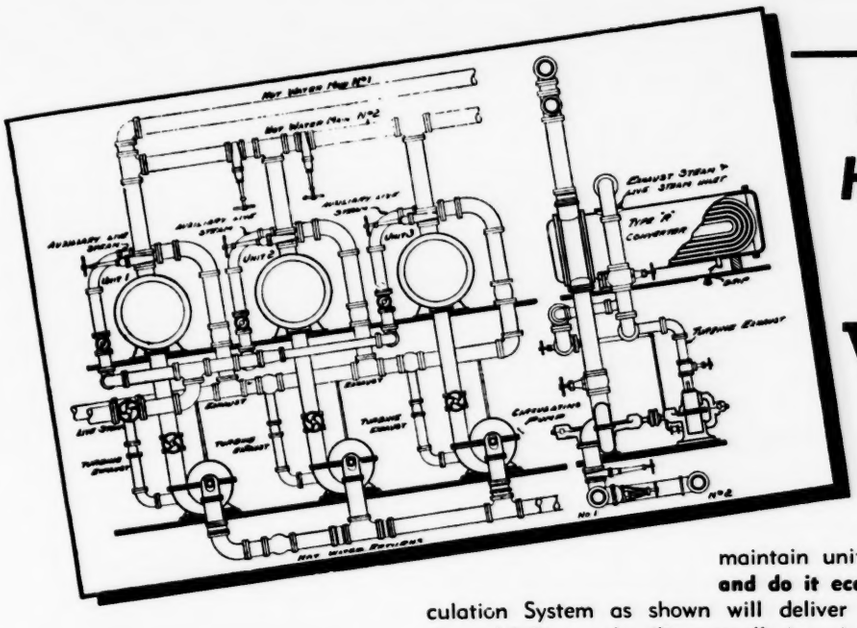
Sales of self-contained air conditioning units so defined by the manufacturer or producer thereof are properly subject to tax.

• The Housing and Home Finance Agency and the Department of Commerce have made arrangements to continue the work of the *Uniform Plumbing Code Committee* under the auspices of the Department of Commerce, the HHFA, and other government agencies. Many of the principles involved and many of the standards recommended in this code are applicable to all classes of plumbing installations as well as housing.

• More than *twice as many new dwellings* were started in the first three months of 1948 under FHA inspection as were started under similar conditions in 1947. More than four times as many dwelling units, built under HFA inspection, were completed in the first three months as in the same period last year.

• Largest garden type apartment project for the United States will be Glen Oaks Village in Metropolitan New York, consisting of *8,800 apartment units* in buildings of early American architecture arranged on 1/5 of a 175-acre site. The remaining acreage will be playgrounds, tennis courts, lawns, and parks.

• An *aerodynamic gas turbine* in which the working fluid is air circulated under pressure is one of several pieces of new equipment described in a report of recent developments in Switzerland now on sale by the Office of Technical Services, Department of Commerce.



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Whitlock Convertors produce abundant hot water from exhaust or live steam, maintain uniform heating efficiency year after year—**and do it economically, too.** The Whitlock Forced Circulation System as shown will deliver hot water over long carrying lines with dependability, and utilizes small size piping or tubing. This compact system easily handles overload demands. Whitlock Convertors are also suitable for gravity circulation systems. Once installed there is no need for special supervision since Whitlock Convertors are practically fool-proof, virtually self-operating. Come to Whitlock for sound heating engineering service and equipment. Write for information.

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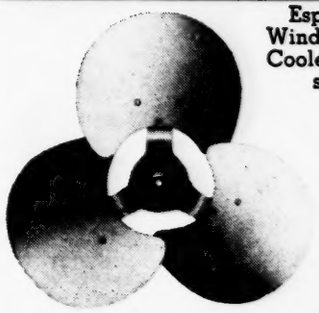

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Meier Nu-air
TRADE MARK REGISTERED

OFFSET PROPS

These bright aluminum blades are precision-built, static-balanced and insulated from the spider and hub to guarantee accuracy and smooth, efficient performance.

Available in 16" to 24" sizes and in 18° and 23° pitch. Others 10" to 54"—11° to 34° pitch. For complete details, write for Bulletin No. 2208. Meier Electric & Machine Co., Inc., 3525 E. Washington Street, Indianapolis 7, Indiana.

There's a Meier Nu-air Precision Prop for every type of ventilating equipment.

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Now, lagging material on pipes, ducts, boilers and hot water tanks can be secured firmly and given a sized finish *in a single operation.*

Apply the canvas, asbestos, fiberglas or other non-conductor—using Arabol Lagging Adhesive as the bond. The adhesive dries in 4 to 6 hours; the job is completed. No paint need be used on the sized finish—unless you prefer to add one coat for appearance. The Arabol method eliminates the time-consuming task of sewing; lowers labor costs. Maintenance is simplified—grease, oil, soot and dirt wash off easily. And the adhesive is vermin-proof . . . fire-retardant, too.

Arabol Lagging Adhesive has successfully passed rigorous tests by independent laboratories. The results show that it retains its adhesive powers despite exposure to extreme temperatures, to immersion in water, and to live steam.

Write us today for detailed facts and figures. Don't place open specifications on lagging work—ask for Arabol Lagging Adhesive. You can depend on it to fill your most exacting requirements for both utility and appearance. Also, ask about our cork cement for adhering cork to cork on refrigerator lines.

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NEW CATALOGS

Air Eliminators

Bulletin No. 170 features air eliminators of a new design for low pressure steam heating systems. Also described are eliminators for hot water heating systems. List prices, capacities, demands and weights are included.—*Sarco Co., Inc., Empire State Building, New York 1, N. Y.* 89

Floats

Nicholson welded floats of stainless steel monel metal, and plated steel in various shapes are described in Bulletin No. 348 with list prices and selection data. —*W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.* 90

Flexible Hose Prices

Price lists as of February 1, 1948, on Flexaust, Portovent, and Bloflex, light weight flexible hoses, include selection and installation data. — *American Ventilating Hose Co., 15 Park Row, New York 7, N. Y.* 91

Boiler Feed and Condensate Return

Two new bulletins, Nos. 201 and 202, describe the Roth condensate return units and boiler feed units, respectively. Bulietins contain general catalog data and prices.—*Roy E. Roth Co., Rock Island, Ill.*.....92

Cooling Towers

Two new bulletins describe the Binks mechanical draft cooling tower Types 2K-S (spray-filled) and 2K-W (wood-filled). Recent design changes and capacity tables are included.—*Water Cooling Division, Binks Manufacturing Co., 3126-36 Carroll Ave., Chicago 12, Ill.* 93

V Belt Drives

Heavy duty sheaves for multiple V belt drives are described in an 8-page catalog. Tables and charts of dimensions, capacities, and combinations, for specification and selection of V belt drives, are included.—*Congress Drive Division, Tann Corp., 375 E. Outer Drive, Detroit 12, Mich.* 94

Hot Water Systems

Domestic hot water heaters and the "Taco-One" venturi hot water heating system with circulators, fittings, and valves are described in catalog F99. Design and sizing data for systems and exhausts are included with descriptions of several new products and new rating tables on convertors. The back cover shows a tabulation of average service water requirements for various types of buildings.—*Taco Heaters, Inc., 137 South St., Providence 3, R. I.* 95

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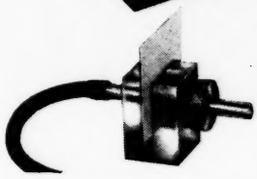
with

DWYER TRANSPARENT

SMOKE GAGE



KNOW what your burner or furnace is doing—BE SURE you are getting the maximum amount of CO_2 with clean combustion. The DWYER Smoke Gage gives you an actual sample of smoke for comparison with the DWYER Smoke Chart. For greater fuel saving efficiency with soot-free burning, it's the DWYER Smoke Gage . . . . precision-made, accurate, inexpensive!

HOW TO USE IT: With Smoke Gage terminal tube in smoke pipe opening, force smoke sample through paper in Gage holder with aspirator bulb. Remove paper and compare with Chart. It's that easy!

DWYER No. 910 Smoke Gage . . $8.50 Complete

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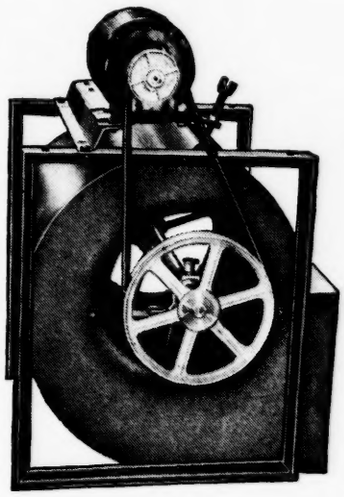

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BLOWER

MASSACHUSETTS . .

By changing the position of the oil cup, the four popular discharges (lower horizontal, upper horizontal, down-blast and up-blast) can be obtained. Sizes 7 to 16½ inches wheel diameter.

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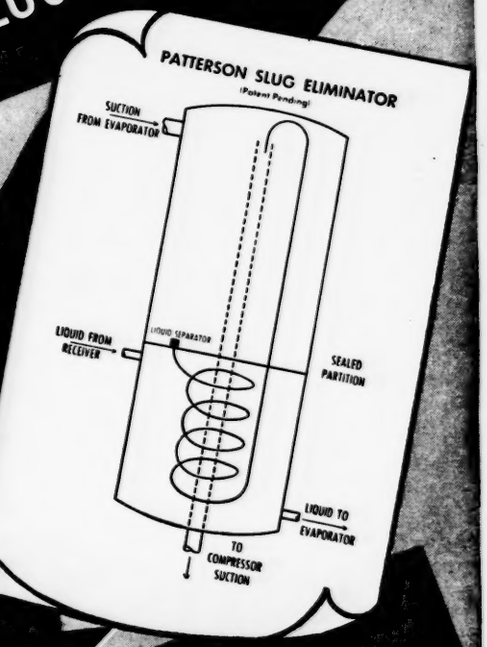
PATTERSON "SLUG ELIMINATOR"



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Order it for your cooler . . . existing or proposed.

The Patterson "Slug Eliminator" is positive in its liquid trapping action and by sub-cooling the refrigerant improves the efficiency of the system. It is simple and effective and has only one moving part — the separating valve.

In writing for further details, including prices and delivery, describe fully the cooler setup you wish to protect. We might have some installation suggestions.

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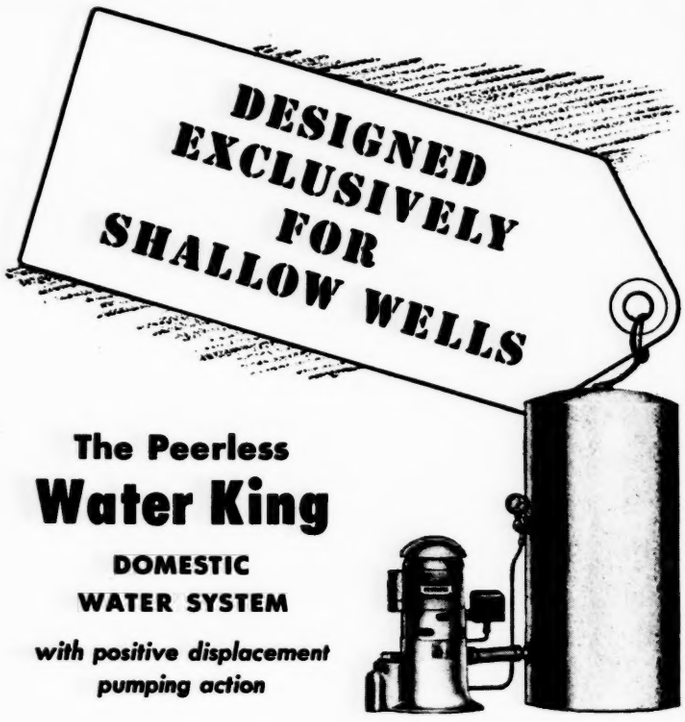

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DOMESTIC
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with positive displacement pumping action

Outperforms other shallow well systems because it's built specifically for low lift applications.

Capacities: 275 to 860 Gals. per Hr.
Lifts: to 20 ft.

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Double or Single Pipe Systems — Over well or offset. Capacities: up to 7500 gals. per hour. Pressures up to 40 lbs. or more.
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Steel Boiler

Catalog 92 describes the Kewanee Round "R" steel boiler. This is a round residential heating boiler inclosed in a square jacket and engineered to serve systems with either steam, vapor or hot water. Ratings, specifications, and measurements are provided and cross section diagrams in full color are included.—*Kewanee Boiler Corp., Kewanee, Ill.* **96**

Cooling Units

A new line of giant sized vertical air discharge cooling units is described in an 8-page catalog. These units are for large scale cooling of water, oil, and gas as well as for steam and vapor condensing. Dissipating capacities are from 3- to 15-million Btu per hour. —*Young Radiator Company, Racine, Wis.* **97**

Electrode Guide

A thumb-indexed pocket guide to Airco welded electrodes shows selection and application data for various metals. — *Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.* **98**

Flexible Tubing

Titeflex all metal flexible tubing is illustrated and described in a 24-page catalog featuring a new bronze tube for nominal steam pressure applications, monel and stainless steel tubing for higher temperature and corrosion resistance. — *Titeflex, Inc., 468 Frelinghuysen Ave., Newark 5, N. J.* **99**

Radiant Heating

A consumer booklet on radiant heating describes in general the history of radiant heating for residences and shows applications of copper tube in residential radiant heating. Other applications of copper tube and plumbing, screening, and roofing products are also illustrated.—*Chase Brass & Copper Co., Waterbury 91, Conn.* **100**

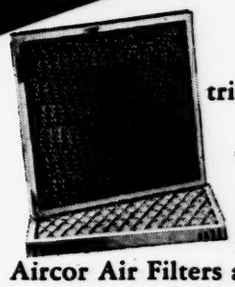
General Ventilation

Under the title, "Fresh Air at the Touch of a Switch", a non-technical bulletin describes the various applications of air handling equipment with photographs of the various uses of fans in homes, commercial buildings, industry, and on the farm. — *National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit 2, Mich.*.....**101**

Stainless Plate Steel

A 32-page booklet illustrated with photographs, tables and charts describes stainless steel plates (solid and clad) and their fabrication. The booklet shows available sizes and weights and provides directions for shop work, cutting, machining, welding, etc. — *Allegheny Ludlum Steel Corp., 2036 Oliver Building, Pittsburgh 22, Pa.* **102**

Aircor Air Filter Protection Means Effective Dust Collection



Aircor's expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

Aircor Air Filters available in standard 1" and 2" thickness with filters for industrial and special applications in 2" and 4" thickness.

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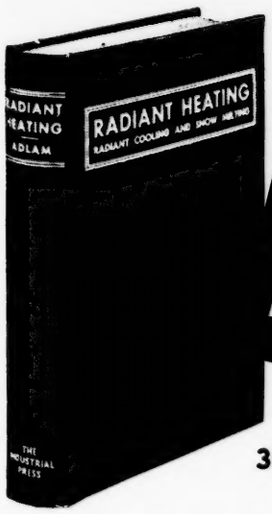

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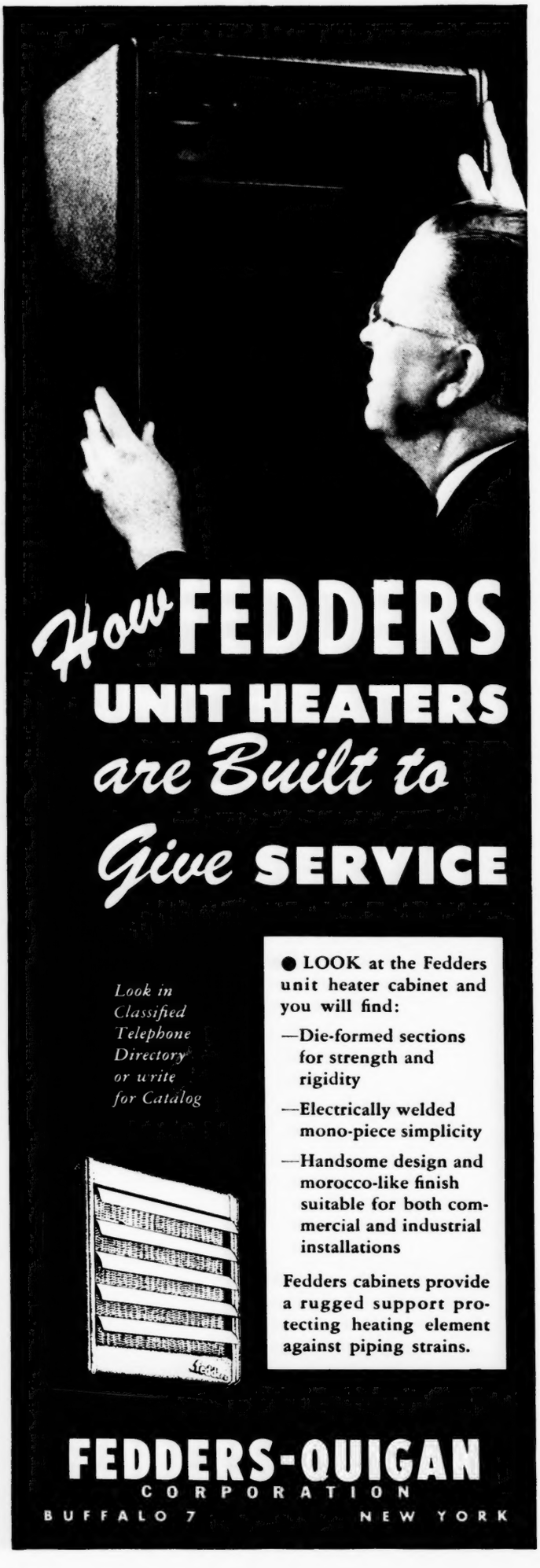
THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y.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Unit Coolers

New models of Blo-cold industrial unit coolers are described and illustrated in catalog No. 932, 16-pages, 2-colors. These are dry coil units designed for cold storage applications.—*Acme Industries, Inc., Jackson, Mich.* **103**

Vibration Control

A 4-page bulletin describes the use of standard and heavy density Vibracork for vibration control. Application drawings illustrate different installation conditions.—*The Korfund Co., 48-33 Thirty-Second Place, Long Island City 1, N. Y.* **104**

Electric Motors

Geared electric motors are shown in the 16-page, full color bulletin including cutaway drawings, and engineering specifications of U. S. Syncrogear motors. —*U. S. Electrical Motors, Incorporated, Los Angeles 54, Calif.* **105**

Flue Gas Analyzer

A 4-page bulletin, No. 1136A, describes the new Davis continuous indicating and recording flue gas analyzer.—*Davis Emergency Equipment Co., 45 Halleck St., Newark 4, N. J.* **106**

Sheet Metal Tools

Five basic tools used in sheet metal work, designed especially for the hobbyist and the professional metalworker who fabricates in light gages are described and illustrated in a 16-page catalog.—*Berkroy Products Inc., 2516 N. Ontario St., Burbank, Calif.* **107**

Air and Gas Blower

A 4-page bulletin, No. G-82, illustrates and briefly describes the Roots-Connersville line of blowers, pumps and motors.—*Roots-Connersville Blower Corp., 900 W. Mount St., Connersville, Ind.* **108**

High Pressure Tube Fittings

Tube fittings for high pressure hydraulic systems with Flodar design, application, and specifications, are described and illustrated in a 6-page, 2-color catalog with sizing tables and construction diagrams.—*Flodar Corp., 331 Frankfort Ave., Cleveland, Ohio.* **109**

Hot Water Heating Controls

Sarcotherm's water control for hot water and radiant heating is the subject of a 20-page catalog of indoor and outdoor control for various types of hot water heating systems. Controls for radiant heating systems are described with diagrams and specifications, sizing charts and photographs.—*Sarcotherm Controls, Inc., Suite 2922 Empire State Building, New York 1, N. Y.* **110**

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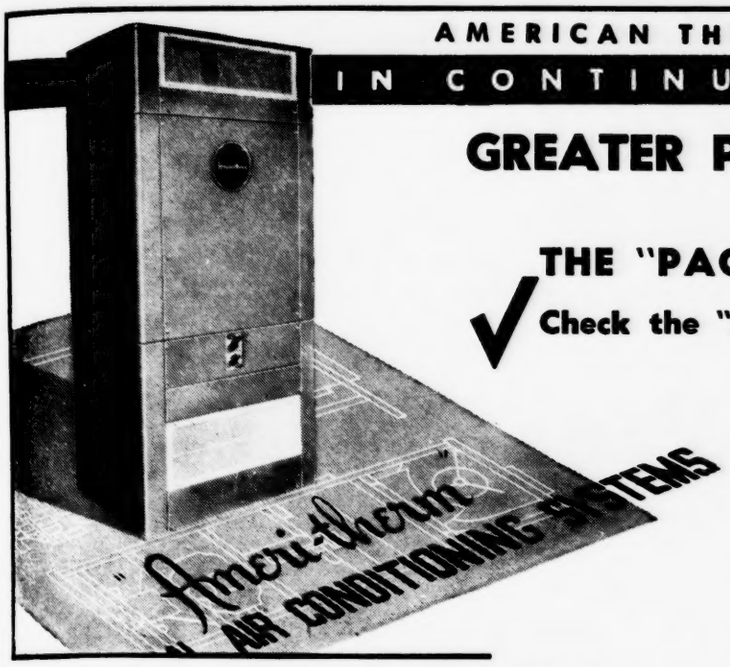

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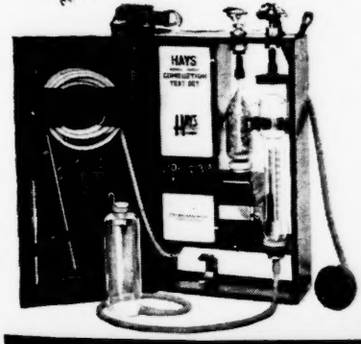

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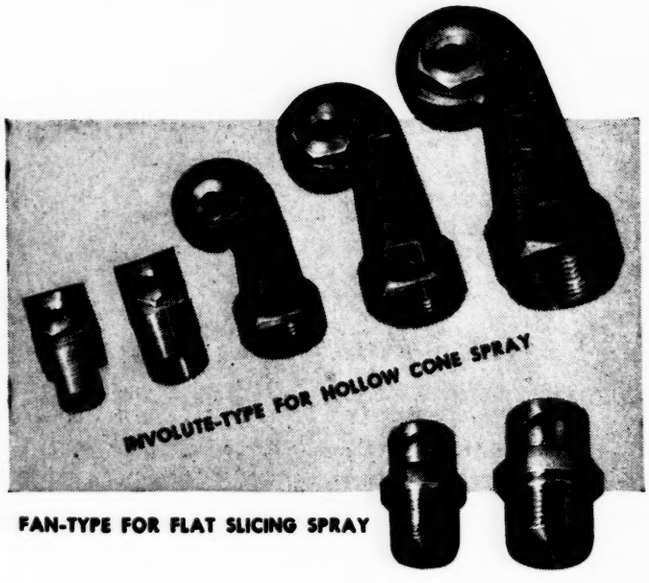

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104 Mermaid Avenue Philadelphia 18, Pa.

Fuel Pulverizers

The two types of Blaw-Knox solid fuel pulverizers are described in an 8-page bulletin with cutaway diagrams and application photographs.—*Blaw-Knox Co., Pittsburgh, Pa.* 111

Grilles and Registers

Grilles and registers featuring airfoil-shaped blades are described in a new catalog with list prices and installation diagrams. — *Titus Manufacturing Corp., Waterloo, Iowa.* 112

Valve Price List

A condensed price list for automatic control and regulating valves, with selection data and illustrations of each valve, is issued as Bulletin No. 48-2. — *The Electrimatic Div., The Simoniz Co., 2100 Indiana Ave., Chicago 16, Ill.* 113

Brass Fittings

Bulletin No. 352 presents data on how to recognize tube fitting types and a price and size list on five types of Imperial brass fittings.—*Imperial Brass Manufacturing Company, 1200 West Harrison St., Chicago 7, Ill.* 114

Hose Fittings

A catalog section on fittings for various types of hoses features recommendations for attaching couplings and a discussion of coupling threads.—*The B. F. Goodrich Co., Akron, Ohio.* 115

Steel Heating Boilers

International water tube steel heating boilers Type C, for commercial and industrial buildings, are described in an 8-page catalog with sectional drawings illustrating various firing methods and construction details. — *The International Boiler Works Co., East Stroudsburg, Pa.* 116

JUNE, 1948

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Print your name and address, mail to
Editor, HEATING AND VENTILATING,
148 Lafayette Street, New York 13, N. Y.

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96	97	98	99	100	101	102
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TAL Portable Tube Bender for radiant heating

Bend right on the spot, fast and accurately

Now, with this new light-weight machine that can be carried in one hand, you can speed-up radiant heating installations . . . for the Tal Tube Bender handles, without annealing, *hard copper* tubing as well as soft, both K and L, in all diameters from 3/8" to 1" in all standard radii. Changeovers from one size to another can be made in 40 seconds. One man does everything without help. No flattening, no kinks, no wrinkles. Made and guaranteed by Tal, the world's largest exclusive producer of pipe and tube bending equipment. Write today for data bulletin.

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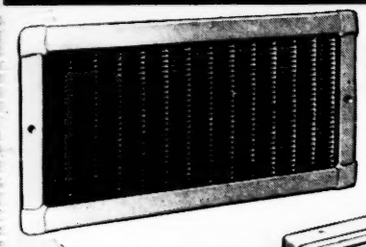
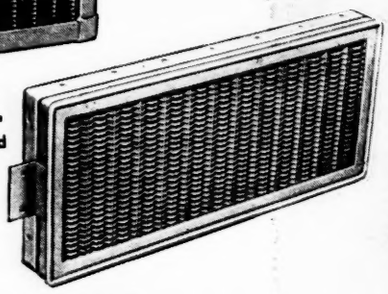
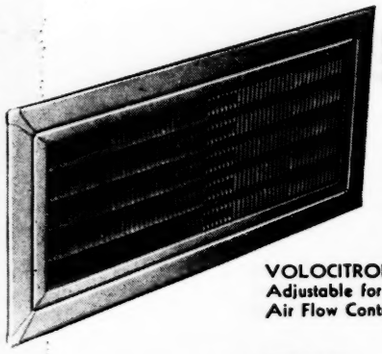


MODEL "E" GRILLES and REGISTERS

MODEL "F" GRILLES and REGISTERS





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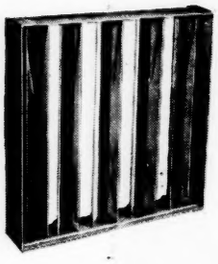

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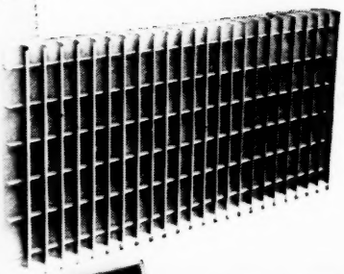

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INDUSTRIAL DEGREE-DAYS
April, 1948

City	55F Base	45F Base
Baltimore, Md.	82	4
Buffalo, N. Y.	227	59
Chicago, Ill.	172	31
Cleveland, Ohio	171	35
Detroit, Mich.	184	42
Indianapolis, Ind.	106	7
New York, N. Y.	171	18
Philadelphia, Pa.	113	7
Pittsburgh, Pa.	128	20
St. Louis, Mo.	60	1

CANADIAN DEGREE-DAYS FOR APRIL, 1948*

City	April 1948	April Normal	Cumulative, Sept. 1 to Apr. 30 1947-48	Cumulative, Sept. 1 to Apr. 30 Normal
Calgary, Alta.	1113	750	9131	8631
Charlottetown, P. E. I.	909	858	8096	7727
Crescent Valley, B. C.	666	624	7038	7328
Edmonton, Alta.	1146	780	9803	9369
Fort William, Ont.	858	888	9741	9478
Grande Prairie, Alta.	1260	822	10019	9617
Halifax, N. S.	827	768	7059	6902
London, Ont.	558	642	7165	6968
Medicine Hat, Alta.	822	606	8537	8194
Moncton, N. B.	861	798	8385	8094
Montreal, P. Q.	663	715	8097	8088
North Bay, Ont.	735	813	9134	8746
Ottawa, Ont.	633	726	8306	8364
Penticton, B. C.	594	507	6024	6073
Porquis Junction, Ont.	879	972	10184	10586
Prince George, B. C.	984	738	8702	8506
Quebec City, P. Q.	792	849	8576	8848
Regina, Sask.	1101	816	10812	10457
St. John, N. B.	819	792	7679	7576
Saskatoon, Sask.	1167	725	10980	10081
Toronto, Ont.	551	669	6580	6895
Vancouver, B. C.	570	498	5112	4977
Victoria, B. C.	549	504	4626	4569
Windsor, Ont.	426	582	6345	6454
Winnipeg, Man.	894	822	10513	10444

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

The Department reports a slight revision in the figure for March for Moncton, N. B., as published in last month's issue. Corrected figure is 1342.

Getting Personal

C. Tasker

Cyril Tasker (*A Review of British Experiments in Domestic Heating*, page 78) was born and educated in Manchester, England, and received both his Bachelor's and Master's degrees from the University of Manchester. For some years he was on the staff of the Fuel Research Board (part of the Department of Scientific and Industrial Research). He came to Canada in 1930 to become Senior Research Fellow at the Ontario Research Foundation in Toronto, Ontario. He joined the ASHVE in 1935, and served for seven years as a member of the Committee on Research and for three years as a member of the Council of the Society.

He was appointed Director of Research to the Society

in 1943. He is a member of the ASRE, the Institution of Heating and Ventilating Engineers (England), and is a Fellow of the Institute of Fuels (England). He has for many years contributed to technical publications in the United States, Canada, and England.

K. M. Smith

Kenneth M. Smith *(Maintenance of Foundry Ventilation Equipment,* page 67) has had considerable experience in foundry work with the Caterpillar Tractor Co.

Born in Rockford, Ill., he attended the University of Illinois where he received his B.S. in Mechanical Engineering in 1939. Following graduation he spent four years as apprentice engineer and staff engineer in the Plant Engineering Department of the Caterpillar Tractor Co., working on the design and erection of industrial exhaust systems, and on the design and erection of heat treating equipment. Mr. Smith was advanced to foundry engineer for that company in 1943.

He is a member of the American Foundrymen's Association, American Society for Metals, and the American Society of Mechanical Engineers.

. . . Since the Last Issue

R. V. Clark, formerly district manager of the **Penn Electric Switch Co.,** Dayton office, has been named manager of heating control sales. Mr. Clark will make his headquarters at the main office in Goshen, Ind. He has been with Penn for 20 years. To succeed Mr. Clark, the company appointed **E. A. Price** as district manager of the Dayton office. Mr. Price was formerly manager of the company's Dallas, Texas district. He is replaced in the Dallas office by **James Stiver,** who recently joined the sales organization. In addition, Penn announced the opening of a new Cleveland sales office in Room 902 of the N.B.C. Building at 815 Superior Avenue. **W. S. Lossie** was appointed district manager of the new Cleveland territory.

Crane Co., Chicago, manufacturer of plumbing and heating, valves and fittings, has announced a number of promotions within the company, effective from May 15. **L. W. Moore,** general manager of sales and branch houses, has been made director of purchases. Taking Mr. Moore's place is **C. T. Pollock,** at present Central district manager. **W. A. Burbine,** Chicago branch manager, will become Central district manager, and **G. G. Lindholm,** at present assistant manager at the branch, is promoted to manager. The newly appointed assistant to the manager at this branch is **H. H. Stift,** now manager of branch plumbing and heating sales.

Burke B. Roche has been elected vice-president by the board of directors of the **Binks Manufacturing Co.,** manufacturers of paint spraying equipment, cooling towers and industrial spray nozzles. Prior to his election as vice-president, Mr. Roche was in charge of the Industrial Division of the company.

Carl E. Brock, Jr. has been appointed branch manager at the St. Louis office of the **Ilg Electric Ventilating Co.** Mr. Brock has served a two-year apprenticeship with Ilg in the Pittsburgh office. **H. L. Branigin,** former branch manager at St. Louis, is retiring after serving the company for over 25 years.

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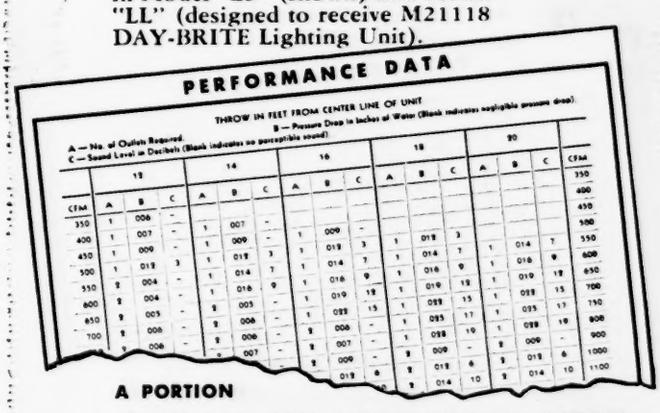
CEILING OUTLETS

A new approach to air distribution — *line-type* outlets that can be used singly or end-to-end in continuous strips. Keyed to modern architectural concepts, they provide a vital contribution to continuity of design. High diffusion efficiency results in rapid induction of room air into the primary stream, quickly equalizing the temperature differential. Made in Model "LS" (shown) and Model "LL" (designed to receive M21118 DAY-BRITE Lighting Unit).



PERFORMANCE DATA

THROW IN FEET FROM CENTER LINE OF UNIT

A — No. of Outlets Required
B — Pressure Drop in Inches of Water (Blank indicates negligible pressure drop)
C — Sound Level in Decibels (Blank indicates no perceptible sound)

	12			14			16			18			20			
CFM	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	CFM
350	1	.006	-													350
400	1	.007	-	1	.007	-										400
450	1	.009	-	1	.009	-	1	.009	-							450
500	1	.012	3	1	.012	3	1	.012	3	1	.012	3				500
550	2	.004	-	1	.014	7	1	.014	7	1	.014	7	1	.014	7	550
600	2	.004	-	1	.016	9	1	.016	9	1	.016	9	1	.016	9	600
650	2	.005	-	2	.003	-	1	.019	13	1	.019	13	1	.019	13	650
700	2	.006	-	2	.004	-	1	.022	15	1	.022	15	1	.022	15	700
	2	.006	-	2	.006	-	2	.006	-	1	.025	17	1	.025	17	750
				2	.007	-	2	.007	-	1	.028	19	1	.028	19	800
							2	.009	-	2	.009	-	2	.009	-	900
							2	.012	6	2	.012	6	2	.012	6	1000
							2	.014	10	2	.014	10	2	.014	10	1100

A PORTION OF THE DATA FROM WHICH LINE-O-FLO OUTLETS CAN BE ACCURATELY SELECTED

Knowing the CFM available and the THROW required, the number of standard units needed is quickly obtained from performance data tables such as the one shown in part above.

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Ask for Bulletin F-2741 and get full performance data, dimensions, description, principles of operation, typical installation methods, and suggested uses. Write today.

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The dictionary says O.K. is probably derived from the Choctaw oke *meaning "yes" or "it is." But that ain't the way we heerd it. They say a fellow used O.K. as the abbreviation of "Oll Kerrect."*

While the "K" on our fittings stands for Kuhns, it could aptly stand for "Kerrect" . . . because that's what "K" Fittings are! They're precision-cast, precision-machined, precision-inspected.

Every "K" fitting is guaranteed to be correct in wall thickness, tapping, and for drilling—free from sand holes, cold checks, and other blemishes.

The "K" line of fittings that fit includes:

- Standard and Extra Heavy Cast-Iron Screwed Fittings
- Standard and Extra Heavy Companion Flanges
- Standard Flanged Fittings
- Drainage Fittings

THE KUHNS BROS. CO.

DAYTON 1, OHIO

K

Combined Sales Facilities at Malleable Iron Fittings Company, Branford, Conn., and Kuhns Bros. Co., Dayton, Ohio

"K" PRECISION FITTINGS

The **Sporlan Valve Co.** of St. Louis, Mo., announces the opening of two additional sales offices, one in San Francisco, Cal., the other in Atlanta, Ga. **Merle G. Haynes** will be in charge of the San Francisco office located at 1334 Potrero Ave. He will cover an eight-state territory, including Arizona, California, Idaho, Nevada, Oregon, Utah, Washington, and a portion of Montana. **David M. Lawson** will handle the Southeastern territory with headquarters at 735 Spring St., N. W., Atlanta, Ga. His territory comprises the states of Alabama, Florida, Georgia, Mississippi, North and South Carolina, Tennessee and a portion of Louisiana.

Elmer H. Weihe, who has been with **Owens-Corning Fiberglas Corp.** and predecessor companies for over 30 years, has been named assistant treasurer of the Fiberglas Corporation. Mr. Weihe has been credit manager of the Fiberglas Corporation since 1942. He began his career in the glass industry in Evansville, Indiana, in 1917 when he entered the employ of the Graham Glass Company, then a subsidiary of the Owens Bottle Company, as assistant auditor. He was assistant treasurer of Graham when Owens Bottle Company merged with Owens-Illinois Glass Company in 1929. In 1931 Mr. Weihe transferred to the Owens-Illinois general manufacturing department in Toledo. When Owens-Corning Fiberglas Corporation was formed in 1938 he joined the new company, holding the three-in-one position of office manager, purchasing agent and credit manager.

E. H. Weihe

Acme Industries, Inc. has announced the appointment of two new regional representatives. **Coward-Eastman Co.,** 43 S. 23rd St., Philadelphia 3, Pa., has been appointed to represent Acme in Eastern Pennsylvania, Southern New Jersey and Delaware. **Paller Engineering Co.,** 1037 N. Pennsylvania St., Indianapolis 4, Ind., was appointed for Central Indiana.

The purchase of the Atlas Imperial Diesel Engine plant and facilities at Mattoon, Illinois, has been announced by F. M. Young, president of **Young Radiator Co.** The Young Radiator Co. manufactures heat transfer products and has plants and offices at Racine, Wis., with sales and engineering offices in principal cities.

The Chicago offices of **Allen-Bradley Co.,** manufacturers of electric motor controls, Milwaukee, Wis., are now located in new and larger quarters at 445-447 North LaSalle St., Chicago 10, Ill. John McC. Price is district manager.

The Marley Company, Inc., announces the change of its Los Angeles office address to 810 South Spring Street. **Harold A. Dresser** recently joined the Los Angeles sales department after a two-month intensive training period in the Marley home office in Kansas City.

Roy B. McCrady, field engineer of **Alco Valve Co.,** St. Louis manufacturers of refrigerant control valves, has been promoted from the company's Chicago office to take charge of the southwest territory which includes Texas, Oklahoma and Louisiana.

Henry Valve Co., Chicago, announces the appointment of **Evan Jones** as chief engineer. Previous to his joining the Henry Valve Company in 1945, Mr. Jones was with Alco Valve Co., Carnegie-Illinois Steel Co., West Penn Power Co. and Westinghouse Electric Co.

Rheem Manufacturing Co. has appointed **Reese B. Lloyd** manager of plants and **R. J. Seltzer** manager of product design and development.

Michael A. Gaal has been named refrigeration representative for **McQuay, Inc.**, Minneapolis manufacturer of refrigeration and air-conditioning equipment, in Michigan, northern Ohio, northwestern Pennsylvania and northwestern New York.

The appointment of **Walter W. Lige** as manager of nationa' accounts for the **Bell & Gossett Co.** is reported. Mr. Lige became associated with B & G in 1940 and for a number of years was in charge of the Cleveland office.

General Controls Co., manufacturers of automatic temperature, pressure and flow controls, announce the opening of a new Denver factory branch office. The new office is located at 1162 Elati Street, Denver 4, Colo. M. S. Wilson is branch manager of this office.

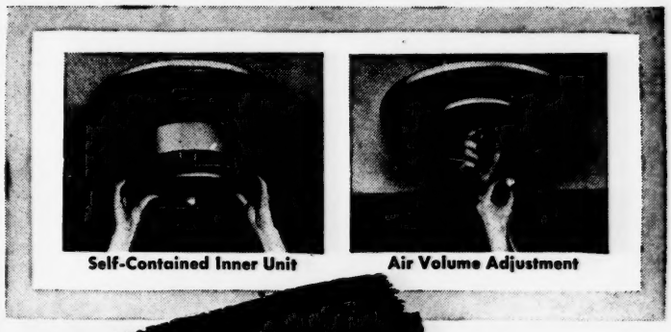
Edgar A. Jett, II, has been named assistant director of Armour Research Foundation of **Illinois Institute of Technology.** Mr. Jett joined the foundation staff September 1, 1947, as director of sponsor relations. Previously he was with the General Electric company as director of sales for the six-state, Great Lakes district with headquarters in Cleveland.

Walter P. Barrett has been appointed manager of the New York district office of **Dravo Corp.**, Pittsburgh. His office is located at 30 Church St. Formerly assistant manager of the corporation's Machinery Division district office in Philadelphia, Mr. Barrett has been with Dravo 13 years. He resides in Short Hills, N. J.

Appointment of **O. W. Bynum** as general sales manager of **Carrier Corp.**, manufacturer of air conditioning, refrigeration and industrial heating equipment, is announced. Since 1946 Mr. Bynum has been manager of direct sales for Carrier. In his new assignment, he will continue these duties in addition to directing the over-all line organization of the sales division under A. P. Shanklin, vice-president in charge of the sales division. Mr. Bynum joined the Carrier organization in 1930 as a student engineer. After serving in various engineering capacities in Newark, N. J., then the home office of the corporation, and in Chicago, he was branch manager in Dallas, Texas, for seven years. Subsequently he became manager of the Southern Region and from 1944 to 1946 was district manager located in Chicago.

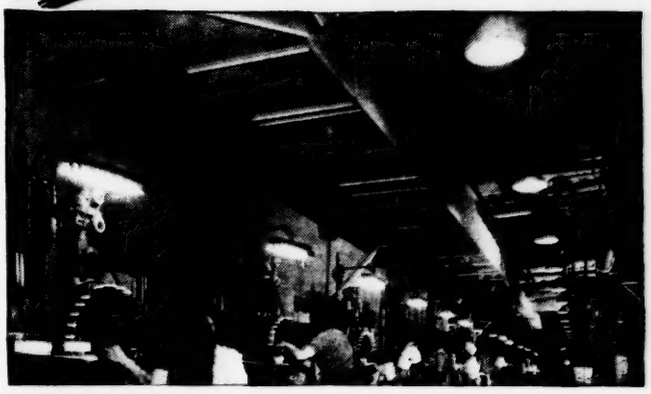
O. W. Bynum

Dr. Harold Vagtborg, president and director of **Midwest Research Institute** at Kansas City, Mo., since its inception on January 1, 1945, yesterday announced to the board of governors his resignation to permit him to accept appointment, effective September 1, 1948, as president and director of Southwest Research Institute based in Houston, Texas; as Director of the Institute of Inventive Research; and as Director of the Foundation of Applied Research; a'so as Technical Director of the 3,500-acre Essar Ranch, all located just outside the city limits of San Antonio, Texas. All four institutions were founded by Tom B. Slick, oil man and rancher of San Antonio. **Dr. George E. Ziegler**, executive scientist, will continue as executive scientist, and also will take over the administrative responsibilities of Midwest Research Institute until Dr. Vagtborg's successor is announced.



FAST INSTALLATION

"Custom-made" air pattern with Kno-Draft Adjustable Diffusers in Champion Spark Plug Plant



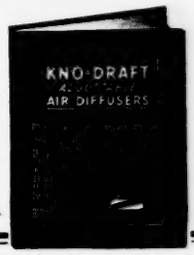
PROBLEM: A ceramic kiln radiates heat on one side and a cold window-filled wall creates drafts on the other. The space is long and narrow with low head room. The occupants work in short sleeves. Unusually large volumes of supply air have to be brought in to combat the heat of the kiln. Space for duct work above the room is limited so that diffusers have to be spaced much closer than usual. The supply air stream has to be directed slightly above the horizontal and evenly distributed so that no drafts are felt by the personnel.

SOLUTION: Kno-Draft Adjustable Air Diffusers were chosen because of their ability to control air direction, volume and throw. A "custom-made" air pattern was created which thoroughly mixed room and supply air, maintained uniform temperature throughout and eliminated drafts, hot spots, and cold spots. *Installation* was fast. Kno-Draft self-contained inner units cut installation time up to 50%. *Balancing* was fast. CFM readings were taken directly with Velometer. A twist of the wrist changes air volume on each diffuser.

Free — New handbook on Air Diffusion

It contains the latest engineering data on air diffusion and is profusely illustrated with charts, photographs, sketches and dimension prints that simplify the selection, application, location, assembly, erection, testing and adjusting of Kno-Draft Adjustable Air Diffusers. It is designed to help you get top efficiency from an air conditioning system by creating "custom-made" air distribution patterns.

For your FREE copy, please write Dept. E-13.



W. B. CONNOR ENGINEERING CORP.

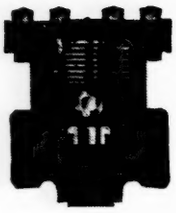
Air Diffusion • Air Purification • Air Recovery

112 East 32nd Street — **New York 16, N. Y.**

IN CANADA: Douglas Engineering Co., Ltd., 190 Murray Street, Montreal 3, P. Q.

More Service Tests Confirm that Nicholson Steam Traps Furnish...

2 to 6 Times MORE DRAINAGE Capacity



Recent comparative tests by large users of steam traps again showed the unequalled drainage capacity of Nicholson traps. The record low for steam waste was also shown. Some Nicholson features: larger valve orifice; operate on lowest temperature differential; no freeze-ups; no adjustment of valve or seat.

Put a Nicholson Trap on Test

See why leading plants are increasingly standardizing on Nicholson steam traps. We'll gladly send one for testing. 5 types for every application: size ¼" to 2"; pressure to 225 lbs. BULLETIN 1047.

W. H. NICHOLSON & CO. 199 OREGON STREET WILKES-BARRE, PA.

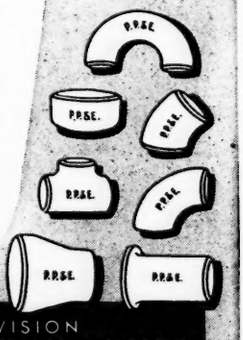
Valves • Traps • Steam Specialties

SAVE INSTALLATION and Production Time on *Stainless* Piping

with P. P. & E. *Stainless* STEEL WELDING FITTINGS

P. P. & E. stainless steel welding fittings reduce the cost of installing a stainless piping system —because any system can be constructed with them simply by straight cutting of tubes to desired lengths and plain butt-welding. Complicated "angle" cutting and fitting is eliminated; fewer welds are needed; and faster, uniformly sound welds are assured. A clean, lastingly efficient, trouble-free system is the result since pockets and sharp corners that cause erosion, product accumulation, and pressure drop are eliminated.

These fittings are available in Stainless Types 304, 316, and 347 to match piping and tubing of various wall thicknesses in sizes from ¾" through 12". Send for Catalog S-309 which gives complete specifications and list prices of the world's most complete line of stainless welding fittings.



STAINLESS ALLOY DIVISION
PITTSBURGH PIPING and EQUIPMENT COMPANY
10 43rd Street · Pittsburgh, Penna.
World's Largest Manufacturer of Stainless Steel Welding Fittings

General Electric has named **F. C. Kurung** manager of manufacturing for its automatic heating equipment division of the Air Conditioning Department. Mr. Kurung's new responsibilities will be in addition to his present duties as manager of general services at G. E.'s Bloomfield plant. He began his G-E career in 1919 as an apprentice, graduating in 1924 as a tool and die maker. **D. W. McLenegan** has been appointed assistant to the manager of marketing for General Electric's Air Conditioning Department. Formerly assistant to the manager of engineering, Mr. McLenegan will continue his activities on G. E.'s Recruiting Sub-Committee, securing technical personnel for the department and supervising the test engineers and rotational engineers' program. In his new post Mr. McLenegan will devote much of his time to long range product planning investigations, and will be available for special assignments. **S. J. Levine** has been appointed manager of engineering for General Electric's Air Conditioning Department. Replacing **W. E. Johnson,** who has been transferred to G. E.'s Nucleonics Department, Mr. Levine joined G. E. in 1928 as a student engineer.

A $2,500,000 expansion program, announced by **Brown Instrument Company,** Philadelphia, will add more than 60% to its present manufacturing space and a proportionate increase in employment. The program includes construction of a four-story addition to the main plant at Wayne Junction.

Franklin F. Bogardus, district sales manager for **Roots-Connersville Blower Corp.,** Connersville, Ind., has opened an office in Cleveland, Ohio, at 2306 East 22nd St., in the Plymouth Building, and will cover about the same territory previously handled from the factory.

Illinois Engineering Co., Chicago, announces the appointment of the **Industrial Sales Co.,** heating and ventilating engineers, 414 Majestic Building, Columbus 15, Ohio, as their representative in that territory.

Perfection Stove Co., Cleveland, Ohio, announces the appointment of **A. B. MacLaren** as assistant sales manager of its Furnace Division, which is headed by E. B. Goodwin. Mr. MacLaren has been with Perfection since 1930, when he came with the organization as a field engineer.

Wolverine Tube Division has announced the appointment of **L. H. Littlefield** as general sales manager for Wolverine. Mr. Littlefield was formerly affiliated with the Holtzer-Cabot Division of the First Industrial Corp.

James H. Lahey will direct York-Heat automatic heating equipment sales in the Middle Western territory, **York-Shipley, Inc.,** has announced.

John W. Wallace has been named sales manager of **Fresh'nd-Air Co.,** manufacturers of electric air circulators and humidifiers.

Lawrence C. Johnson, 36, manager of the **Minneapolis-Honeywell Regulator Co.** branch in Milwaukee, died April 29 at Northwestern Hospital, Minneapolis, after a short illness. He had been with Honeywell since 1928, having been located in the home office in Minneapolis and the New York and St. Louis branches.

Peter D. White, who was elected president of **The Babcock & Wilcox Tube Co.** on April 8, died suddenly Thursday, May 6 while en route by automobile from the company's plant at Beaver Falls, Pa., to the Alliance (Ohio) plant. He was 59 years of age.

Henry Valve Co., Chicago, announces the appointment of **George Schaefer** as works manager. Mr. Schaefer has been with the company for eight years where he has specialized largely in problems of production.

James B. Morrow was elected to serve as president of **Bituminous Coal Research, Inc.**, at a meeting of the organization's board of directors May 20 in Columbus, Ohio. He is the first vice-president of Pittsburgh Consolidation Coal Co., Pittsburgh, Pa. He succeeds Howard N. Eavenson.

E. H. Lambert has been appointed eastern sales representative for **American Thermal Industries, Inc.**, to handle Ameri-therm packaged air conditioner. Mr. Lambert will operate out of Stamford, Connecticut, and cover the Eastern Seaboard.

A new plant has begun manufacturing Freon refrigerants at East Chicago, Ind., and officials of **Kinetic Chemicals, Inc**, say it will increase production capacity for these products by 60%.

A number of personnel changes including new regional, branch and division managership have been announced by the **Minneapolis-Honeywell Regulator Co. Kent L. Wilson** has been promoted to manager of the southwest region with headquarters in Dallas. A graduate of the University of Minnnesota, Mr. Wilson joined Honeywell as a student engineer in 1935. In 1944, he was named Detroit branch manager, a position he has held until his latest promotion. Succeeding him in Detroit is **T. S. Carley** who has been sales manager of the stoker and wholesale divisions at the home office. Mr. Carley joined Honeywell in 1935 in the production department as an apprentice. **Walter J. Baak,** who has been Moduflow sales manager of the midwestern region, with headquarters in Chicago, has been promoted to sales manager of the wholesale division. He joined Honeywell in 1935 and worked in the factory as a punch press operator while attending the Dunwoody Institute. **G. M. Kingsland,** who has been heading sales activities of the company's control devices and specialties departments, is taking over new duties in the heating controls division. Mr. Kingsland joined Honeywell in 1934 and has worked in various sales capacities. **William S. Robards** has been appointed Milwaukee branch manager. He succeeds L. C. Johnson who died after a short illness in May of this year. Mr. Robards has been in the Milwaukee office since 1944 in charge of industrial division sales.

CONVENTION PROGRAMS

ASHVE Advance Program Semi-Annual Meeting, 1948

The Massachusetts Chapter committee has completed arrangements for the Bretton Woods, N. H., meeting of ASHVE to be held June 20-23. A meeting of the Council and several committee meetings will be held on Sunday, June 20. Three technical sessions have been arranged by the program committee, H. E. Stacey, Jr., chairman. A program of amusements and scenic trips by chartered bus has also been arranged.

Sunday, June 20

10:00 a.m. Committee on Research Meeting

2:30 p.m. Council Meeting

Monday, June 21

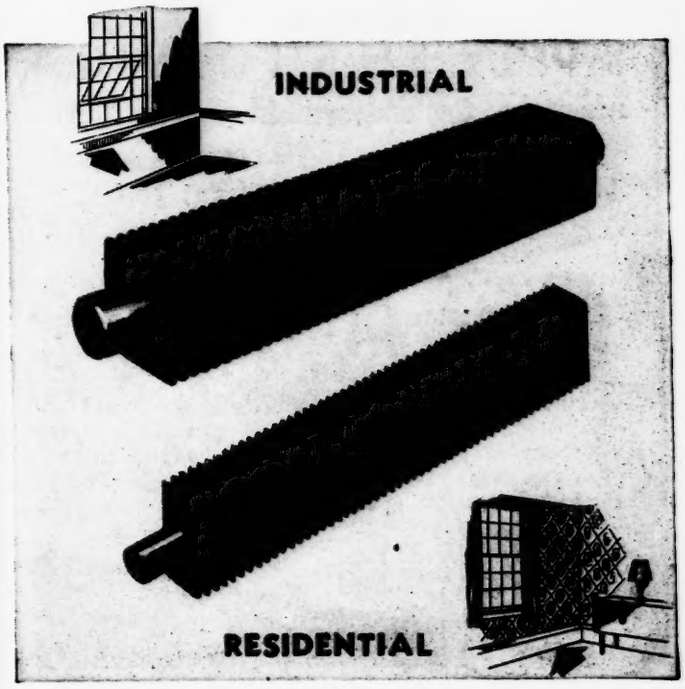
10:00 a.m. Technical Session—Physiological Factors in Air Conditioning

Report of Committee on Research — L. N. Hunter, Chairman

Sanitary Significance of Ventilation, by W. F. Wells

Mount Washington Weather Conditions, by Donald B. Chapman

Thermal Insulation of Clothing, by C. P. Yaglou



SIMPLICITY... THE KEYNOTE OF Vulcan Radiation

Simplicity in design — fin on tube construction gives extended heating surface in compact easily handled unit that is light in weight, requires few fittings.

Simplicity in application — Vulcan is as easily installed as a length of pipe wherever adequate, uniform heat is needed — in small spaces, large areas, high, low or in hard-to-get-at-places.

A Vulcan installation is always attractive, unobtrusive — harmonizes with the interior of any style or type of building — business, public, industrial or residential.

For the best in modern heating design, look for the name "Vulcan-Hartford" — stamped on every radiator.

In stock at your local source.

RESIDENTIAL
Vulcan Radi-Vector — easily installed along the baseboard — attractive — adequate heat — greater room utility.

INDUSTRIAL
Vulcan Standard Radiation — proven heating design for ships, railroad cars, hospitals, churches, schools and industrial plants.

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RADIATOR MANUFACTURERS FOR OVER TWO DECADES